

DIPEPTIDYL PEPTIDASE INHIBITORS

Related Application

[0001] This application claims the benefit of U.S. Provisional Application No. 60/457,785, filed March 25, 2003, which is incorporated herein by reference.

Field of the Invention

[0002] The invention relates to compounds that may be used to inhibit dipeptidyl peptidases as well as compositions of matter and kits comprising these compounds. The present invention also relates to methods for inhibiting dipeptidyl peptidases as well as treatment methods using compounds according to the present invention.

Description of Related Art

[0003] Dipeptidyl Peptidase IV (IUBMB Enzyme Nomenclature EC.3.4.14.5) is a type II membrane protein that has been referred to in the literature by a wide a variety of names including DPP4, DP4, DAP-IV, FAP β , adenosine deaminase complexing protein 2, adenosine deaminase binding protein (ADAbp), dipeptidyl aminopeptidase IV; Xaa-Pro-dipeptidyl-aminopeptidase; Gly-Pro naphthylamidase; postproline dipeptidyl aminopeptidase IV; lymphocyte antigen CD26; glycoprotein GP110; dipeptidyl peptidase IV; glycylproline aminopeptidase; glycylproline aminopeptidase; X-prolyl dipeptidyl aminopeptidase; pep X; leukocyte antigen CD26; glycylprolyl dipeptidylaminopeptidase; dipeptidyl-peptide hydrolase; glycylprolyl aminopeptidase; dipeptidyl-aminopeptidase IV; DPP IV/CD26; amino acyl-prolyl dipeptidyl aminopeptidase; T cell triggering molecule Tp103; X-PDAP. Dipeptidyl Peptidase IV is referred to herein as "DPP-IV."

[0004] DPP-IV is a non-classical serine aminodipeptidase that removes Xaa-Pro dipeptides from the amino terminus (N-terminus) of polypeptides and proteins. DPP-IV dependent slow release of dipeptides of the type X-Gly or X-Ser has also been reported for some naturally occurring peptides.

[0005] DPP-IV is constitutively expressed on epithelial and endothelial cells of a variety of different tissues (intestine, liver, lung, kidney and placenta), and is also found in body fluids. DPP-IV is also expressed on circulating T-lymphocytes and has been shown to be synonymous with the cell-surface antigen, CD-26. DPP-IV has been implicated in a number of disease states, some of which are discussed below.

[0006] DPP-IV is responsible for the metabolic cleavage of certain endogenous peptides (GLP-1 (7-36), glucagon) *in vivo* and has demonstrated proteolytic activity against a variety of other peptides (GHRH, NPY, GLP-2, VIP) *in vitro*.

[0007] GLP-1 (7-36) is a 29 amino-acid peptide derived by post-translational processing of proglucagon in the small intestine. GLP-1 (7-36) has multiple actions *in vivo* including the stimulation of insulin secretion, inhibition of glucagon secretion, the promotion of satiety, and the slowing of gastric emptying. Based on its physiological profile, the actions of GLP-1 (7-36) are believed to be beneficial in the prevention and treatment of type II diabetes and potentially obesity. For example, exogenous administration of GLP-1 (7-36) (continuous infusion) in diabetic patients has been found to be efficacious in this patient population. Unfortunately, GLP-1 (7-36) is degraded rapidly *in vivo* and has been shown to have a short half-life *in vivo* ($t_{1/2}$ =1.5 minutes).

[0008] Based on a study of genetically bred DPP-IV knock out mice and on *in vivo* / *in vitro* studies with selective DPP-IV inhibitors, DPP-IV has been shown to be the primary degrading enzyme of GLP-1 (7-36) *in vivo*. GLP-1 (7-36) is degraded by DPP-IV efficiently to GLP-1 (9-36), which has been speculated to act as a physiological antagonist to GLP-1 (7-36). Inhibiting DPP-IV *in vivo* is therefore believed to be useful for potentiating endogenous levels of GLP-1 (7-36) and attenuating the formation of its antagonist GLP-1 (9-36). Thus, DPP-IV inhibitors are believed to be useful agents for the prevention, delay of progression, and/or treatment of conditions mediated by DPP-IV, in particular diabetes and more particularly, type 2 diabetes mellitus, diabetic dislipidemia, conditions of impaired glucose tolerance (IGT), conditions of impaired fasting plasma glucose (IFG), metabolic acidosis, ketosis, appetite regulation and obesity.

[0009] DPP-IV expression is increased in T-cells upon mitogenic or antigenic stimulation (Mattem, T., et al., *Scand. J. Immunol.*, 1991, 33, 737). It has been reported that inhibitors of DPP-IV and antibodies to DPP-IV suppress the proliferation of mitogen-stimulated and antigen-stimulated T-cells in a dose-dependant manner (Schon, E., et al., *Biol. Chem.*, 1991, 372, 305). Various other functions of T-lymphocytes such as cytokine production, IL-2 mediated cell proliferation and B-cell helper activity have been shown to be dependent on DPP-IV activity (Schon, E., et al., *Scand. J. Immunol.*, 1989, 29, 127). DPP-IV inhibitors, based on boroProline, (Flentke, G. R., et al., *Proc. Nat. Acad. Sci. USA*, 1991, 88, 1556) although unstable, were effective at inhibiting antigen-induced lymphocyte proliferation and IL-2 production in murine CD4+ T-helper cells. Such boronic acid

inhibitors have been shown to have an effect *in vivo* in mice causing suppression of antibody production induced by immune challenge (Kubota, T. et al., *Clin. Exp. Immun.*, 1992, 89, 192). The role of DPP-IV in regulating T lymphocyte activation may also be attributed, in part, to its cell-surface association with the transmembrane phosphatase, CD45. DPP-IV inhibitors or non-active site ligands may possibly disrupt the CD45-DPP-IV association. CD45 is known to be an integral component of the T-cell signaling apparatus. It has been reported that DPP-IV is essential for the penetration and infectivity of HIV-1 and HIV-2 viruses in CD4+ T-cells (Wakselman, M., Nguyen, C., Mazaleyrat, J.-P., Callebaut, C., Krust, B., Hovanessian, A. G., Inhibition of HIV-1 infection of CD 26+ but not CD 26-cells by a potent cyclopeptidic inhibitor of the DPP-IV activity of CD 26. Abstract P.44 of the 24^{sup}.th European Peptide Symposium 1996). Additionally, DPP-IV has been shown to associate with the enzyme adenosine deaminase (ADA) on the surface of T-cells (Kameoka, J., et al., *Science*, 193, 26 466). ADA deficiency causes severe combined immunodeficiency disease (SCID) in humans. This ADA-CD26 interaction may provide clues to the pathophysiology of SCID. It follows that inhibitors of DPP-IV may be useful immunosuppressants (or cytokine release suppressant drugs) for the treatment of among other things: organ transplant rejection; autoimmune diseases such as inflammatory bowel disease, multiple sclerosis and rheumatoid arthritis; and the treatment of AIDS.

[0010] It has been shown that lung endothelial cell DPP-IV is an adhesion molecule for lung-metastatic rat breast and prostate carcinoma cells (Johnson, R. C., et al., *J. Cell. Biol.*, 1993, 121, 1423). DPP-IV is known to bind to fibronectin and some metastatic tumor cells are known to carry large amounts of fibronectin on their surface. Potent DPP-IV inhibitors may be useful as drugs to prevent metastases of, for example, breast and prostate tumors to the lungs.

[0011] High levels of DPP-IV expression have also been found in human skin fibroblast cells from patients with psoriasis, rheumatoid arthritis (RA) and lichen planus (Raynaud, F., et al., *J. Cell. Physiol.*, 1992, 151, 378). Therefore, DPP-IV inhibitors may be useful as agents to treat dermatological diseases such as psoriasis and lichen planus.

[0012] High DPP-IV activity has been found in tissue homogenates from patients with benign prostate hypertrophy and in prostatosomes. These are prostate derived organelles important for the enhancement of sperm forward motility (Vanhoof, G., et al., *Eur. J. Clin. Chem. Clin. Biochem.*, 1992, 30, 333). DPP-IV inhibitors may also act to suppress sperm motility and therefore act as a

male contraceptive agent. Conversely, DPP-IV inhibitors have been implicated as novel for treatment of infertility, and particularly human female infertility due to Polycystic ovary syndrome (PCOS, Stein-Leventhal syndrome) which is a condition characterized by thickening of the ovarian capsule and formation of multiple follicular cysts. It results in infertility and amenorrhea.

[0013] DPP-IV is thought to play a role in the cleavage of various cytokines (stimulating hematopoietic cells), growth factors and neuropeptides.

[0014] Stimulated hematopoietic cells are useful for the treatment of disorders that are characterized by a reduced number of hematopoietic cells or their precursors *in vivo*. Such conditions occur frequently in patients who are immunosuppressed, for example, as a consequence of chemotherapy and/or radiation therapy for cancer. It was discovered that inhibitors of dipeptidyl peptidase type IV are useful for stimulating the growth and differentiation of hematopoietic cells in the absence of exogenously added cytokines or other growth factors or stromal cells. This discovery contradicts the dogma in the field of hematopoietic cell stimulation, which provides that the addition of cytokines or cells that produce cytokines (stromal cells) is an essential element for maintaining and stimulating the growth and differentiation of hematopoietic cells in culture. (See, *e.g.*, PCT Intl. Application No. PCT /US93/017173 published as WO 94/03055).

[0015] DPP-IV in human plasma has been shown to cleave N-terminal Tyr-Ala from growth hormone-releasing factor and cause inactivation of this hormone. Therefore, inhibitors of DPP-IV may be useful in the treatment of short stature due to growth hormone deficiency (Dwarfism) and for promoting GH-dependent tissue growth or re-growth.

[0016] DPP-IV can also cleave neuropeptides and has been shown to modulate the activity of neuroactive peptides substance P, neuropeptide Y and CLIP (Mentlein, R., Dahms, P., Grandt, D., Kruger, R., Proteolytic processing of neuropeptide Y and peptide YY by dipeptidyl peptidase IV, *Regul. Pept.*, 49, 133, 1993; Wetzell, W., Wagner, T., Vogel, D., Demuth, H.-U., Balschun, D., Effects of the CLIP fragment ACTH 20-24 on the duration of REM sleep episodes, *Neuropeptides*, 31, 41, 1997). Thus DPP-IV inhibitors may also be useful agents for the regulation or normalization of neurological disorders.

[0017] Several compounds have been shown to inhibit DPP-IV. Nonetheless, a need still exists for new DPP-IV inhibitors that have advantageous potency, stability, selectivity, toxicity and/or pharmacodynamics properties. In this regard, a novel class of DPP-IV inhibitors are provided herein.

SUMMARY OF THE INVENTION

[0018] The present invention relates to compounds that have activity for inhibiting DPP-IV. It is noted that these compounds may also have activity for inhibiting other S9 proteases and thus may be used against these other S9 proteases as well as DPP-IV. The present invention also provides compositions, articles of manufacture and kits comprising these compounds.

[0019] In one embodiment, a pharmaceutical composition is provided that comprises a DPP-IV inhibitor according to the present invention as an active ingredient. Pharmaceutical compositions according to the invention may optionally comprise 0.001%-100% of one or more DPP-IV inhibitors of this invention. These pharmaceutical compositions may be administered or coadministered by a wide variety of routes, including for example, orally, parenterally, intraperitoneally, intravenously, intraarterially, transdermally, sublingually, intramuscularly, rectally, transbuccally, intranasally, liposomally, via inhalation, vaginally, intraocularly, via local delivery (for example by catheter or stent), subcutaneously, intraadiposally, intraarticularly, or intrathecally. The compositions may also be administered or coadministered in slow release dosage forms.

[0020] The invention is also directed to kits and other articles of manufacture for treating disease states associated with DPP-IV.

[0021] In one embodiment, a kit is provided that comprises a composition comprising at least one DPP-IV inhibitor of the present invention in combination with instructions. The instructions may indicate the disease state for which the composition is to be administered, storage information, dosing information and/or instructions regarding how to administer the composition. The kit may also comprise packaging materials. The packaging material may comprise a container for housing the composition. The kit may also optionally comprise additional components, such as syringes for administration of the composition. The kit may comprise the composition in single or multiple dose forms.

[0022] In another embodiment, an article of manufacture is provided that comprises a composition comprising at least one DPP-IV inhibitor of the present invention in combination with packaging materials. The packaging material may comprise a container for housing the composition. The container may optionally comprise a label indicating the disease state for which the composition is to be administered, storage information, dosing information and/or instructions regarding how to administer the composition. The kit may also optionally comprise additional components, such as

syringes for administration of the composition. The kit may comprise the composition in single or multiple dose forms.

[0023] Also provided are methods for preparing compounds, compositions and kits according to the present invention. For example, several synthetic schemes are provided herein for synthesizing compounds according to the present invention.

[0024] Also provided are methods for using compounds, compositions, kits and articles of manufacture according to the present invention.

[0025] In one embodiment, the compounds, compositions, kits and articles of manufacture are used to inhibit DPP-IV.

[0026] In another embodiment, the compounds, compositions, kits and articles of manufacture are used to treat a disease state for which DPP-IV possesses activity that contributes to the pathology and/or symptomology of the disease state.

[0027] In another embodiment, a compound is administered to a subject wherein DPP-IV activity within the subject is altered, preferably reduced.

[0028] In another embodiment, a prodrug of a compound is administered to a subject that is converted to the compound *in vivo* where it inhibits DPP-IV.

[0029] In another embodiment, a method of inhibiting DPP-IV is provided that comprises contacting DPP-IV with a compound according to the present invention.

[0030] In another embodiment, a method of inhibiting DPP-IV is provided that comprises causing a compound according to the present invention to be present in a subject in order to inhibit DPP-IV *in vivo*.

[0031] In another embodiment, a method of inhibiting DPP-IV is provided that comprises administering a first compound to a subject that is converted *in vivo* to a second compound wherein the second compound inhibits DPP-IV *in vivo*. It is noted that the compounds of the present invention may be the first or second compounds.

[0032] In another embodiment, a therapeutic method is provided that comprises administering a compound according to the present invention.

[0033] In another embodiment, a method of inhibiting cell proliferation is provided that comprises contacting a cell with an effective amount of a compound according to the present invention.

[0034] In another embodiment, a method of inhibiting cell proliferation in a patient is provided that comprises administering to the patient a therapeutically effective amount of a compound according to the present invention.

[0035] In another embodiment, a method of treating a condition in a patient which is known to be mediated by DPP-IV, or which is known to be treated by DPP-IV inhibitors, comprising administering to the patient a therapeutically effective amount of a compound according to the present invention.

[0036] In another embodiment, a method is provided for using a compound according to the present invention in order to manufacture a medicament for use in the treatment of disease state which is known to be mediated by DPP-IV, or which is known to be treated by DPP-IV inhibitors.

[0037] In another embodiment, a method is provided for treating a disease state for which DPP-IV possesses activity that contributes to the pathology and/or symptomology of the disease state, the method comprising: causing a compound according to the present invention to be present in a subject in a therapeutically effective amount for the disease state.

[0038] In another embodiment, a method is provided for treating a disease state for which DPP-IV possesses activity that contributes to the pathology and/or symptomology of the disease state, the method comprising: administering a first compound to a subject that is converted *in vivo* to a second compound such that the second compound is present in the subject in a therapeutically effective amount for the disease state. It is noted that the compounds of the present invention may be the first or second compounds.

[0039] In another embodiment, a method is provided for treating a disease state for which DPP-IV possesses activity that contributes to the pathology and/or symptomology of the disease state, the method comprising: administering a compound according to the present invention to a subject such that the compound is present in the subject in a therapeutically effective amount for the disease state.

[0040] In another embodiment, a method is provided for treating a cell proliferative disease state comprising treating cells with a compound according to the present invention in combination with an anti-proliferative agent, wherein the cells are treated with the compound according to the present invention before, at the same time, and/or after the cells are treated with the anti-proliferative agent, referred to herein as combination therapy. It is noted that treatment of one agent before another is referred to herein as sequential therapy, even if the agents are also administered together. It is noted

that combination therapy is intended to cover when agents are administered before or after each other (sequential therapy) as well as when the agents are administered at the same time.

[0041] Examples of diseases that may be treated by administration of compounds and compositions according to the present invention include, but are not limited to conditions mediated by DPP-IV, in particular diabetes, more particular type 2 diabetes mellitus, diabetic dislipidemia, conditions of impaired glucose tolerance (IGT), conditions of impaired fasting plasma glucose (IFG), metabolic acidosis, ketosis, appetite regulation, obesity, immunosuppressants or cytokine release regulation, autoimmune diseases such as inflammatory bowel disease, multiple sclerosis and rheumatoid arthritis, AIDS, cancers (prevention of metastases, for example, breast and prostate tumors to the lungs), dermatological diseases such as psoriasis and lichen planus, treatment of female infertility, osteoporosis, male contraception and neurological disorders.

[0042] It is noted in regard to all of the above embodiments that the present invention is intended to encompass all pharmaceutically acceptable ionized forms (*e.g.*, salts) and solvates (*e.g.*, hydrates) of the compounds, regardless of whether such ionized forms and solvates are specified since it is well known in the art to administer pharmaceutical agents in an ionized or solvated form. It is also noted that unless a particular stereochemistry is specified, recitation of a compound is intended to encompass all possible stereoisomers (*e.g.*, enantiomers or diastereomers depending on the number of chiral centers), independent of whether the compound is present as an individual isomer or a mixture of isomers. Further, unless otherwise specified, recitation of a compound is intended to encompass all possible resonance forms and tautomers. With regard to the claims, the language "compound comprising the formula" is intended to encompass the compound and all pharmaceutically acceptable ionized forms and solvates, all possible stereoisomers, and all possible resonance forms and tautomers unless otherwise specifically specified in the particular claim.

[0043] It is further noted that prodrugs may also be administered which are altered *in vivo* and become a compound according to the present invention. The various methods of using the compounds of the present invention are intended, regardless of whether prodrug delivery is specified, to encompass the administration of a prodrug that is converted *in vivo* to a compound according to the present invention. It is also noted that certain compounds of the present invention may be altered *in vivo* prior to inhibiting DPP-IV and thus may themselves be prodrugs for another compound.

Such prodrugs of another compound may or may not themselves independently have DPP-IV inhibitory activity.

BRIEF DESCRIPTION OF THE FIGURE

[0044] Figure 1 illustrates a ribbon diagram overview of the structure of DPP-IV, highlighting the secondary structural elements of the protein.

[0045] Figure 2 depicts different, representative 5 membered ring structures that may be formed when R₃ and R₄ are taken together to form a substituted or unsubstituted ring.

[0046] Figure 3 depicts different, representative 6 membered ring structures that may be formed when R₃ and R₄ are taken together to form a substituted or unsubstituted ring.

[0047] Figure 4 depict additional representative 5 or 6 membered ring structures that may be formed when R₃ and R₄ are taken together to form a substituted or unsubstituted ring.

[0048] The rings shown in Figures 2, 3 and 4 are unsubstituted. It is noted that the rings may optionally be further substituted by one or more substituents.

DEFINITIONS

[0049] Unless otherwise stated, the following terms used in the specification and claims shall have the following meanings for the purposes of this Application.

[0050] "Alicyclic" means a moiety comprising a non-aromatic ring structure. Alicyclic moieties may be saturated or partially unsaturated with one, two or more double or triple bonds. Alicyclic moieties may also optionally comprise heteroatoms such as nitrogen, oxygen and sulfur. The nitrogen atoms can be optionally quaternerized or oxidized and the sulfur atoms can be optionally oxidized. Examples of alicyclic moieties include, but are not limited to moieties with C₃ - C₈ rings such as cyclopropyl, cyclohexane, cyclopentane, cyclopentene, cyclopentadiene, cyclohexane, cyclohexene, cyclohexadiene, cycloheptane, cycloheptene, cycloheptadiene, cyclooctane, cyclooctene, and cyclooctadiene.

[0051] "Aliphatic" means a moiety characterized by a straight or branched chain arrangement of constituent carbon atoms and may be saturated or partially unsaturated with one, two or more double or triple bonds.

[0052] "Alkenyl" represented by itself means a straight or branched, unsaturated, aliphatic radical having a chain of carbon atoms having at least one double bond between adjacent carbon

atoms. C_X alkenyl and C_{X-Y} alkenyl are typically used where X and Y indicate the number of carbon atoms in the chain. For example, C_{2-6} alkenyl includes alkenyls that have a chain of between 2 and 6 carbons.

[0053] "Alkoxy" means an oxygen moiety having a further alkyl substituent. The alkoxy groups of the present invention can be optionally substituted.

[0054] "Alkyl" represented by itself means a straight or branched, saturated or unsaturated, aliphatic radical having a chain of carbon atoms, optionally with oxygen (See "oxaalkyl") or nitrogen atoms (See "aminoalkyl") between the carbon atoms. C_X alkyl and C_{X-Y} alkyl are typically used where X and Y indicate the number of carbon atoms in the chain. For example, C_{1-6} alkyl includes alkyls that have a chain of between 1 and 6 carbons (e.g., methyl, ethyl, propyl, isopropyl, butyl, *sec*-butyl, isobutyl, *tert*-butyl, vinyl, allyl, 1-propenyl, isopropenyl, 1-butenyl, 2-butenyl, 3-butenyl, 2-methylallyl, ethynyl, 1-propynyl, 2-propynyl, and the like). Alkyl represented along with another radical (e.g., as in arylalkyl, heteroarylalkyl) means a straight or branched, saturated or unsaturated aliphatic divalent radical having the number of atoms indicated or when no atoms are indicated means a bond (e.g., (C_{6-10}) aryl (C_{1-3}) alkyl includes, benzyl, phenethyl, 1-phenylethyl, 3-phenylpropyl, 2-thienylmethyl, 2-pyridinylmethyl and the like).

[0055] "Alkylene", unless indicated otherwise, means a straight or branched, saturated or unsaturated, aliphatic, divalent radical. C_X alkylene and C_{X-Y} alkylene are typically used where X and Y indicate the number of carbon atoms in the chain. For example, C_{1-6} alkylene includes methylene ($-\text{CH}_2-$), ethylene ($-\text{CH}_2\text{CH}_2-$), trimethylene ($-\text{CH}_2\text{CH}_2\text{CH}_2-$), tetramethylene ($-\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2-$), 2-butenylene ($-\text{CH}_2\text{CH}=\text{CHCH}_2-$), 2-methyltetramethylene ($-\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_2-$), pentamethylene ($-\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2-$) and the like).

[0056] "Alkylidene" means a straight or branched saturated or unsaturated, aliphatic radical connected to the parent molecule by a double bond. C_X alkylidene and C_{X-Y} alkylidene are typically used where X and Y indicate the number of carbon atoms in the chain. For example, C_{1-6} alkylidene includes methylene ($=\text{CH}_2$), ethylidene ($=\text{CHCH}_3$), isopropylidene ($=\text{C}(\text{CH}_3)_2$), propylidene ($=\text{CHCH}_2\text{CH}_3$), allylidene ($=\text{CH}-\text{CH}=\text{CH}_2$), and the like).

[0057] "Alkynyl" represented by itself means a straight or branched, unsaturated, aliphatic radical having a chain of carbon atoms having at least one triple bond between adjacent carbon atoms. C_X alkynyl and C_{X-Y} alkynyl are typically used where X and Y indicate the number of carbon

atoms in the chain. For example, C₂₋₆ alkynyl includes alkynyls that have a chain of between 2 and 6 carbons.

[0058] "Amino" means a nitrogen moiety having two further substituents where a hydrogen or carbon atom is attached to the nitrogen. For example, representative amino groups include -NH₂, -NHCH₃, -N(CH₃)₂, -NHC₁₋₃-alkyl, -N(C₁₋₃-alkyl)₂ and the like. Unless indicated otherwise, the compounds of the invention containing amino moieties may include protected derivatives thereof. Suitable protecting groups for amino moieties include acetyl, *tert*-butoxycarbonyl, benzyloxycarbonyl, and the like.

[0059] "Aminoalkyl" means an alkyl, as defined above, except where one or more substituted or unsubstituted nitrogen atoms (-N-) are positioned between carbon atoms of the alkyl. For example, an (C₂₋₆) aminoalkyl refers to a chain comprising between 2 and 6 carbons and one or more nitrogen atoms positioned between the carbon atoms.

[0060] "Animal" includes humans, non-human mammals (*e.g.*, dogs, cats, rabbits, cattle, horses, sheep, goats, swine, deer, and the like) and non-mammals (*e.g.*, birds, and the like).

[0061] "Aromatic" means a moiety wherein the constituent atoms make up an unsaturated ring system, all atoms in the ring system are *sp*² hybridized and the total number of pi electrons is equal to 4n+2. An aromatic ring may be such that the ring atoms are only carbon atoms or may include carbon and non-carbon atoms (see Heteroaryl).

[0062] "Aryl" means a monocyclic or polycyclic ring assembly wherein each ring is aromatic or when fused with one or more rings forms an aromatic ring assembly. If one or more ring atoms is not carbon (*e.g.*, N, S), the aryl is a heteroaryl. C_X aryl and C_{X-Y} aryl are typically used where X and Y indicate the number of atoms in the ring.

[0063] "Aryloxy" means an oxygen moiety having a further aryl substituent. The aryloxy groups of the present invention can be optionally substituted.

[0064] "Bicycloalkyl" means a saturated or partially unsaturated fused bicyclic or bridged polycyclic ring assembly.

[0065] "Bicycloaryl" means a bicyclic ring assembly wherein the rings are linked by a single bond or fused and at least one of the rings comprising the assembly is aromatic. C_X bicycloaryl and C_{X-Y} bicycloaryl are typically used where X and Y indicate the number of carbon atoms in the bicyclic ring assembly and directly attached to the ring.

[0066] "Bridging ring" as used herein refers to a ring that is bonded to another ring to form a compound having a bicyclic structure where two ring atoms that are common to both rings are not directly bound to each other. Non-exclusive examples of common compounds having a bridging ring include borneol, norbornane, 7-oxabicyclo[2.2.1]heptane, and the like. One or both rings of the bicyclic system may also comprise heteroatoms.

[0067] "Carbamoyl" means the radical $-\text{OC}(\text{O})\text{NR}_a\text{R}_b$ where R_a and R_b are each independently two further substituents where a hydrogen or carbon atom is attached to the nitrogen.

[0068] "Carbocycle" means a ring consisting of carbon atoms.

[0069] "Carbocyclic ketone derivative" means a carbocyclic derivative wherein the ring contains a $-\text{CO}-$ moiety.

[0070] "Carbonyl" means the radical $-\text{CO}-$. It is noted that the carbonyl radical may be further substituted with a variety of substituents to form different carbonyl groups including acids, acid halides, aldehydes, amides, esters, and ketones.

[0071] "Carboxy" means the radical $-\text{CO}_2-$. It is noted that compounds of the invention containing carboxy moieties may include protected derivatives thereof, *i.e.*, where the oxygen is substituted with a protecting group. Suitable protecting groups for carboxy moieties include benzyl, *tert*-butyl, and the like.

[0072] "Cyano" means the radical $-\text{CN}$.

[0073] "Cycloalkyl" means a non-aromatic, saturated or partially unsaturated, monocyclic, fused bicyclic or bridged polycyclic ring assembly. C_x cycloalkyl and C_{x-y} cycloalkyl are typically used where X and Y indicate the number of carbon atoms in the ring assembly. For example, C_{3-10} cycloalkyl includes cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cyclohexenyl, 2,5-cyclohexadienyl, bicyclo[2.2.2]octyl, adamantan-1-yl, decahydronaphthyl, oxocyclohexyl, dioxocyclohexyl, thiocyclohexyl, 2-oxobicyclo[2.2.1]hept-1-yl, and the like.

[0074] "Cycloalkylene" means a divalent saturated or partially unsaturated, monocyclic or polycyclic ring assembly. C_x cycloalkylene and C_{x-y} cycloalkylene are typically used where X and Y indicate the number of carbon atoms in the ring assembly.

[0075] "Disease" specifically includes any unhealthy condition of an animal or part thereof and includes an unhealthy condition that may be caused by, or incident to, medical or veterinary therapy applied to that animal, *i.e.*, the "side effects" of such therapy.

[0076] "Fused ring" as used herein refers to a ring that is bonded to another ring to form a compound having a bicyclic structure where the ring atoms that are common to both rings are directly bound to each other. Non-exclusive examples of common fused rings include decalin, naphthalene, anthracene, phenanthrene, indole, furan, benzofuran, quinoline, and the like. Compounds having fused ring systems may be saturated, partially saturated, carbocyclics, heterocyclics, aromatics, heteroaromatics, and the like.

[0077] "Halo" means fluoro, chloro, bromo or iodo.

[0078] "Halo-substituted alkyl", as an isolated group or part of a larger group, means "alkyl" substituted by one or more "halo" atoms, as such terms are defined in this Application. Halo-substituted alkyl includes haloalkyl, dihaloalkyl, trihaloalkyl, perhaloalkyl and the like (*e.g.* halo-substituted (C₁₋₃)alkyl includes chloromethyl, dichloromethyl, difluoromethyl, trifluoromethyl, 2,2,2-trifluoroethyl, perfluoroethyl, 2,2,2-trifluoro-1,1-dichloroethyl, and the like).

[0079] "Heteroaryl" means a cyclic aromatic group having five or six ring atoms, wherein at least one ring atom is a heteroatom and the remaining ring atoms are carbon. The nitrogen atoms can be optionally quaternized and the sulfur atoms can be optionally oxidized. Heteroaryl groups of this invention include, but are not limited to, those derived from furan, imidazole, isothiazole, isoxazole, oxadiazole, oxazole, 1,2,3-oxadiazole, pyrazine, pyrazole, pyridazine, pyridine, pyrimidine, pyrroline, thiazole, 1,3,4-thiadiazole, triazole and tetrazole. "Heteroaryl" also includes, but is not limited to, bicyclic or tricyclic rings, wherein the heteroaryl ring is fused to one or two rings independently selected from the group consisting of an aryl ring, a cycloalkyl ring, a cycloalkenyl ring, and another monocyclic heteroaryl or heterocycloalkyl ring. These bicyclic or tricyclic heteroaryls include, but are not limited to, those derived from benzo[b]furan, benzo[b]thiophene, benzimidazole, imidazo[4,5-c]pyridine, quinazoline, thieno[2,3-c]pyridine, thieno[3,2-b]pyridine, thieno[2,3-b]pyridine, indolizine, imidazo[1,2-a]pyridine, quinoline, isoquinoline, phthalazine, quinoxaline, naphthyridine, quinolizine, indole, isoindole, indazole, indoline, benzoxazole, benzopyrazole, benzothiazole, imidazo[1,5-a]pyridine, pyrazolo[1,5-a]pyridine, imidazo[1,2-a]pyrimidine, imidazo[1,2-c]pyrimidine, imidazo[1,5-a]pyrimidine, imidazo[1,5-c]pyrimidine, pyrrolo[2,3-b]pyridine, pyrrolo[2,3-c]pyridine, pyrrolo[3,2-c]pyridine, pyrrolo[3,2-b]pyridine, pyrrolo[2,3-d]pyrimidine, pyrrolo[3,2-d]pyrimidine, pyrrolo[2,3-b]pyrazine, pyrazolo[1,5-a]pyridine, pyrrolo[1,2-b]pyridazine, pyrrolo[1,2-c]pyrimidine, pyrrolo[1,2-

a]pyrimidine, pyrrolo[1,2-a]pyrazine, triazo[1,5-a]pyridine, pteridine, purine, carbazole, acridine, phenazine, phenothiazene, phenoxazine, 1,2-dihydropyrrolo[3,2,1-*hi*]indole, indolizine, pyrido[1,2-a]indole and 2(1H)-pyridinone. The bicyclic or tricyclic heteroaryl rings can be attached to the parent molecule through either the heteroaryl group itself or the aryl, cycloalkyl, cycloalkenyl or heterocycloalkyl group to which it is fused. The heteroaryl groups of this invention can be substituted or unsubstituted.

[0080] "Heteroaryloxy" means an oxygen moiety having a further heteroaryl substituent. The heteroaryloxy groups of the present invention can be optionally substituted.

[0081] "Heteroatom" refers to an atom that is not a carbon atom. Particular examples of heteroatoms include, but are not limited to nitrogen, oxygen, and sulfur.

[0082] "Heteroatom moiety" includes a moiety where the atom by which the moiety is attached is not a carbon. Examples of heteroatom moieties include -N=, -NR_c-, -N⁺(O⁻)=, -O-, -S- or -S(O)₂-, wherein R_c is further substituent.

[0083] "Heterobicycloalkyl" means bicycloalkyl, as defined in this Application, provided that one or more of the atoms within the ring is a heteroatom. For example hetero(C₉₋₁₂)bicycloalkyl as used in this application includes, but is not limited to, 3-aza-bicyclo[4.1.0]hept-3-yl, 2-aza-bicyclo[3.1.0]hex-2-yl, 3-aza-bicyclo[3.1.0]hex-3-yl, and the like.

[0084] "Heterobicycloaryl" means bicycloaryl, as defined in this Application, provided that one or more of the atoms within the ring is a heteroatom. For example, hetero(C₄₋₁₀)bicycloaryl as used in this Application includes, but is not limited to, 2-amino-4-oxo-3,4-dihydropteridin-6-yl, tetrahydroisoquinolinyl, and the like.

[0085] "Heterocycloalkyl" means cycloalkyl, as defined in this Application, provided that one or more of the atoms forming the ring is a heteroatom selected, independently from N, O, or S. Non-exclusive examples of heterocycloalkyl include piperidyl, 4-morpholyl, 4-piperazinyl, pyrrolidinyl, perhydropyrrolizinyl, 1,4-diazaperhydroepinyl, 1,3-dioxanyl, 1,4-dioxanyl and the like.

[0086] "Heterocycloalkylene" means cycloalkylene, as defined in this Application, provided that one or more of the ring member carbon atoms is replaced by a heteroatom.

[0087] "Hydroxy" means the radical -OH.

[0088] "Iminoketone derivative" means a derivative comprising the moiety -C(NR)-, wherein R comprises a hydrogen or carbon atom attached to the nitrogen.

[0089] "Isomers" mean any compound having an identical molecular formulae but differing in the nature or sequence of bonding of their atoms or in the arrangement of their atoms in space. Isomers that differ in the arrangement of their atoms in space are termed "stereoisomers." Stereoisomers that are not mirror images of one another are termed "diastereomers" and stereoisomers that are nonsuperimposable mirror images are termed "enantiomers" or sometimes "optical isomers." A carbon atom bonded to four nonidentical substituents is termed a "chiral center." A compound with one chiral center has two enantiomeric forms of opposite chirality. A mixture of the two enantiomeric forms is termed a "racemic mixture." A compound that has more than one chiral center has 2^{n-1} enantiomeric pairs, where n is the number of chiral centers. Compounds with more than one chiral center may exist as either an individual diastereomer or as a mixture of diastereomers, termed a "diastereomeric mixture." When one chiral center is present a stereoisomer may be characterized by the absolute configuration of that chiral center. Absolute configuration refers to the arrangement in space of the substituents attached to the chiral center. Enantiomers are characterized by the absolute configuration of their chiral centers and described by the *R*- and *S*-sequencing rules of Cahn, Ingold and Prelog. Conventions for stereochemical nomenclature, methods for the determination of stereochemistry and the separation of stereoisomers are well known in the art (*e.g.*, see "Advanced Organic Chemistry", 4th edition, March, Jerry, John Wiley & Sons, New York, 1992).

[0090] "Nitro" means the radical -NO_2 .

[0091] "Oxaalkyl" means an alkyl, as defined above, except where one or more oxygen atoms (-O-) are positioned between carbon atoms of the alkyl. For example, an (C_{2-6}) oxaalkyl refers to a chain comprising between 2 and 6 carbons and one or more oxygen atoms positioned between the carbon atoms.

[0092] "Oxoalkyl" means an alkyl, further substituted with a carbonyl group. The carbonyl group may be an aldehyde, ketone, ester, amide, acid or acid chloride.

[0093] "Pharmaceutically acceptable" means that which is useful in preparing a pharmaceutical composition that is generally safe, non-toxic and neither biologically nor otherwise undesirable and includes that which is acceptable for veterinary use as well as human pharmaceutical use.

[0094] "Pharmaceutically acceptable salts" means salts of inhibitors of the present invention which are pharmaceutically acceptable, as defined above, and which possess the desired

pharmacological activity. Such salts include acid addition salts formed with inorganic acids such as hydrochloric acid, hydrobromic acid, sulfuric acid, nitric acid, phosphoric acid, and the like; or with organic acids such as acetic acid, propionic acid, hexanoic acid, heptanoic acid, cyclopentanepropionic acid, glycolic acid, pyruvic acid, lactic acid, malonic acid, succinic acid, malic acid, maleic acid, fumaric acid, tartatic acid, citric acid, benzoic acid, *o*-(4-hydroxybenzoyl)benzoic acid, cinnamic acid, mandelic acid, methanesulfonic acid, ethanesulfonic acid, 1,2-ethanedisulfonic acid, 2-hydroxyethanesulfonic acid, benzenesulfonic acid, *p*-chlorobenzenesulfonic acid, 2-naphthalenesulfonic acid, *p*-toluenesulfonic acid, camphorsulfonic acid, 4-methylbicyclo[2.2.2]oct-2-ene-1-carboxylic acid, glucoheptonic acid, 4,4'-methylenebis(3-hydroxy-2-ene-1-carboxylic acid), 3-phenylpropionic acid, trimethylacetic acid, tertiary butylacetic acid, lauryl sulfuric acid, gluconic acid, glutamic acid, hydroxynaphthoic acid, salicylic acid, stearic acid, muconic acid and the like.

[0095] Pharmaceutically acceptable salts also include base addition salts which may be formed when acidic protons present are capable of reacting with inorganic or organic bases. Acceptable inorganic bases include sodium hydroxide, sodium carbonate, potassium hydroxide, aluminum hydroxide and calcium hydroxide. Acceptable organic bases include ethanolamine, diethanolamine, triethanolamine, tromethamine, *N*-methylglucamine and the like.

[0096] "Prodrug" means a compound that is convertible *in vivo* metabolically into an inhibitor according to the present invention. The prodrug itself may or may not also have DPP-IV inhibitory activity. For example, an inhibitor comprising a hydroxy group may be administered as an ester that is converted by hydrolysis *in vivo* to the hydroxy compound. Suitable esters that may be converted *in vivo* into hydroxy compounds include acetates, citrates, lactates, tartrates, malonates, oxalates, salicylates, propionates, succinates, fumarates, maleates, methylene-bis-*b*-hydroxynaphthoates, gentisates, isethionates, di-*p*-toluoyltartrates, methanesulfonates, ethanesulfonates, benzenesulfonates, *p*-toluenesulfonates, cyclohexylsulfamates, quinate, esters of amino acids, and the like. Similarly, an inhibitor comprising an amine group may be administered as an amide that is converted by hydrolysis *in vivo* to the amine compound.

[0097] "Protected derivatives" means derivatives of inhibitors in which a reactive site or sites are blocked with protecting groups. Protected derivatives are useful in the preparation of inhibitors or in themselves may be active as inhibitors. A comprehensive list of suitable protecting groups can

be found in T.W. Greene, *Protecting Groups in Organic Synthesis*, 3rd edition, John Wiley & Sons, Inc. 1999.

[0098] "Substituted or unsubstituted" means that a given moiety may consist of only hydrogen substituents through available valencies (unsubstituted) or may further comprise one or more non-hydrogen substituents through available valencies (substituted) that are not otherwise specified by the name of the given moiety. For example, isopropyl is an example of an ethylene moiety that is substituted by $-\text{CH}_3$. In general, a non-hydrogen substituent may be any substituent that may be bound to an atom of the given moiety that is specified to be substituted. Examples of substituents include, but are not limited to, aldehyde, alicyclic, aliphatic, alkyl, alkylene, alkylidene, amide, amino, aminoalkyl, aromatic, aryl, bicycloalkyl, bicycloaryl, carbamoyl, carbocyclyl, carboxyl, carbonyl group, cycloalkyl, cycloalkylene, ester, halo, heterobicycloalkyl, heterocycloalkylene, heteroaryl, heterobicycloaryl, heterocycloalkyl, oxo, hydroxy, iminoketone, ketone, nitro, oxaalkyl, and oxoalkyl moieties, each of which may optionally also be substituted or unsubstituted.

[0099] "Sulfinyl" means the radical $-\text{SO}-$. It is noted that the sulfinyl radical may be further substituted with a variety of substituents to form different sulfinyl groups including sulfinic acids, sulfinamides, sulfinyl esters, and sulfoxides.

[0100] "Sulfonyl" means the radical $-\text{SO}_2-$. It is noted that the sulfonyl radical may be further substituted with a variety of substituents to form different sulfonyl groups including sulfonic acids, sulfonamides, sulfonate esters, and sulfones.

[0101] "Therapeutically effective amount" means that amount which, when administered to an animal for treating a disease, is sufficient to effect such treatment for the disease.

[0102] "Thiocarbonyl" means the radical $-\text{CS}-$. It is noted that the thiocarbonyl radical may be further substituted with a variety of substituents to form different thiocarbonyl groups including thioacids, thioamides, thioesters, and thioketones.

[0103] "Treatment" or "treating" means any administration of a compound of the present invention and includes:

(1) preventing the disease from occurring in an animal which may be predisposed to the disease but does not yet experience or display the pathology or symptomatology of the disease,

(2) inhibiting the disease in an animal that is experiencing or displaying the pathology or symptomatology of the diseased (*i.e.*, arresting further development of the pathology and/or symptomatology), or

(3) ameliorating the disease in an animal that is experiencing or displaying the pathology or symptomatology of the disease (*i.e.*, reversing the pathology and/or symptomatology).

[0104] It is noted in regard to all of the definitions provided herein that the definitions should be interpreted as being open ended in the sense that further substituents beyond those specified may be included. Hence, a C₁ alkyl indicates that there is one carbon atom but does not indicate what are the substituents on the carbon atom. Hence, a C₁ alkyl comprises methyl (*i.e.*, -CH₃) as well as -R_aR_bR_c where R_a, R_b, and R_c may each independently be hydrogen or any other substituent where the atom attached to the carbon is a heteroatom or cyano. Hence, CF₃, CH₂OH and CH₂CN, for example, are all C₁ alkyls.

DETAILED DESCRIPTION OF THE INVENTION

[0105] The present invention relates to compounds, compositions, kits and articles of manufacture that may be used to inhibit dipeptidyl peptidases IV (referred to herein as DPP-IV).

[0106] DPP-IV (EC.3.4.14.5 also known as DPP4, DP4, DAP-IV, adenosine deaminase complexing protein 2, adenosine deaminase binding protein (ADAbp) or CD26) is a 766 residue, 240kDa protein that is a highly specific membrane bound non-classical serine aminodipeptidase. DPP-IV has a serine type mechanism of protease activity, cleaving off dipeptides from the amino-terminus of peptides with proline or alanine at the penultimate position. In addition the slow release of dipeptides of the type X-Gly or X-Ser is reported for some naturally occurring peptides. DPP-IV is constitutively expressed on epithelial and endothelial cells of a variety of different tissues (intestine, liver, lung, kidney and placenta), and is also found in body fluids. DPP-IV is also expressed on circulating T-lymphocytes and has been shown to be synonymous with the cell-surface antigen, CD-26. The wild-type form of full length DPP-IV is described in GenBank Accession Number NM_001935 ("Dipeptidyl peptidase IV (CD 26) gene expression in enterocyte-like colon cancer cell lines HT-29 and Caco-2. Cloning of the complete human coding sequence and changes of dipeptidyl peptidase IV mRNA levels during cell differentiation", Darmoul, D., Lacasa, M., Baricault, L.,

Marguet, D., Sapin, C., Trotot, P., Barbat, A. and Trugnan, G., J. Biol. Chem., 267 (7), 4824-4833, 1992).

[0107] DPP-IV is a member of the S9 family of serine proteases, more particularly the S9B family. Other members of the S9 family include, but are not limited to:

Subfamily S9A: Dipeptidyl-peptidase; Oligopeptidase B (EC 3.4.21.83); Oligopeptidase B; Prolyl oligopeptidase (EC 3.4.21.26);

Subfamily S9B: Dipeptidyl aminopeptidase A; Dipeptidyl aminopeptidase B
Dipeptidyl-peptidase IV (EC 3.4.14.5); Dipeptidyl-peptidase V
Fibroblast activation protein alpha subunit; Seprase

Subfamily S9C: Acylaminoacyl-peptidase (EC 3.4.19.1)

[0108] It is noted that the compounds of the present invention may also possess inhibitory activity for other S9 family members and thus may be used to address disease states associated with these other family members.

1. CRYSTAL STRUCTURE OF DPP-IV

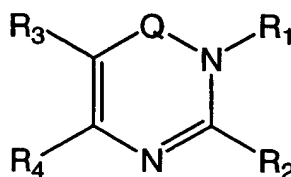
[0109] Syrrx, Inc. (San Diego, California) recently solved the crystal structure of DPP-IV. Knowledge of the crystal structure was used to guide the design of the DPP-IV inhibitors provided herein.

[0110] Figure 1 illustrates a ribbon diagram overview of the structure of DPP-IV, highlighting secondary structural elements of the protein. DPP-IV is a cylindrical shaped molecule with an approximate height of 70 Å and a diameter of 60 Å. The catalytic triad of DPP-IV (Ser642, Asp720 and His752) is illustrated in the center of the figure by a "ball and stick" representation. This triad of amino acids is located in the peptidase domain or catalytic domain of DPP-IV. The catalytic domain is covalently linked to the β-propeller domain. The catalytic domain of DPP-IV includes residues 1-67 and 511-778. The catalytic domain of DPP-IV adopts a characteristic α/β hydrolase fold. The core of this domain contains an 8-stranded β-sheet with all strands being parallel except one. The α-

sheet is significantly twisted and is flanked by three α -helices on one side and five α -helices on the other. The topology of the β -strands is 1, 2, -1x, 2x and (1x) (J. S. Richardson: The anatomy and taxonomy of protein structure; (1981) *Adv. Protein Chem.* 269, 15076-15084.). A number of residues were identified that contribute to the shape and charge characteristics of the active site. Knowledge of these residues has been an important contribution to the design of DPP-IV inhibitors of the present invention.

2. DPP-IV INHIBITORS

[0111] In one embodiment, DPP-IV inhibitors of the present invention comprise Formula I:



I

wherein

Q is selected from the group consisting of CO, SO, SO₂, or C=NR₉;

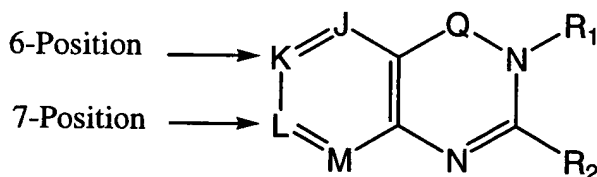
R₁ is hydrogen or is selected from the group consisting of (C₁₋₁₀)alkyl, (C₃₋₁₂)cycloalkyl, (C₃₋₁₂)cycloalkyl(C₁₋₅)alkyl, hetero(C₃₋₁₂)cycloalkyl, aryl(C₁₋₁₀)alkyl, (C₉₋₁₂)bicycloalkyl, hetero(C₄₋₁₂)bicycloalkyl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, amino, cyano, aryl, heteroaryl, hydroxy, alkoxy, aryloxy, heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted;

R₂ is selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, amino, cyano, thio, (C₁₋₁₀)alkyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, hydroxy, alkoxy, aryloxy, heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, and a substituted or unsubstituted 4, 5, 6 or 7 membered ring;

R₃ and R₄ are taken together to form a substituted or unsubstituted 5 or 6 membered ring; and

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0112] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula II:



II

wherein

Q is selected from the group consisting of CO, SO, SO₂, or C=NR₉;

J, K, L, and M are each independently selected from the group of moieties where the ring atom is either C or N;

R₁ is hydrogen or is selected from the group consisting of (C₁₋₁₀)alkyl, (C₃₋₁₂)cycloalkyl, (C₃₋₁₂)cycloalkyl(C₁₋₅)alkyl, hetero(C₃₋₁₂)cycloalkyl, aryl(C₁₋₁₀)alkyl, (C₉₋₁₂)bicycloaryl, hetero(C₄₋₁₂)bicycloaryl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, amino, cyano, aryl, heteroaryl, hydroxy, alkoxy, aryloxy, heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted;

R₂ is selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, amino, cyano, thio, (C₁₋₁₀)alkyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, hydroxy, alkoxy, aryloxy, heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, and a substituted or unsubstituted 4, 5, 6 or 7 membered ring; and

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0113] In one embodiment, DPP-IV inhibitors of the present invention having particular substitution patterns have significantly improved stability in biological assays. Improvement in the stabilities of the compounds in rat liver microsomes, for example, as demonstrated by the increase in

the half life of the test compound in microsomal assays, has been demonstrated in particular substitutions of the DPP-IV inhibitors of the present invention.

[0114] In one particular embodiment, DPP-IV inhibitors comprising the Formula II with substitution at the 6 and/or the 7-positions result in enhanced stability as demonstrated in biological assays. In one particular embodiment, compounds of the Formula II comprise quinazolinones that are substituted at the 6-position, the 7-position, or both the 6 and 7 positions of the compound of Formula II. Non-limiting examples of the compounds of the Formula II include quinazolinone derivatives, naphthyridine derivatives, 4H-pyrido[3,4-d]pyrimidine derivatives, etc.

[0115] In one embodiment, DPP-IV inhibitors comprise compounds of the Formula II wherein K is CR₁₂, where R₁₂ is independently selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, CF₃, cyano, nitro, alkyl, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, a carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted.

[0116] In yet another variation, K is CR₁₂ where R₁₂ is independently selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, CF₃, cyano, nitro, alkyl, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, a carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, and L is nitrogen.

[0117] In another variation,

K is CR₁₂, where R₁₂ is independently selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, CF₃, cyano, nitro, alkyl, aryloxy, heteroaryloxy, amino, and alkoxy, each substituted or unsubstituted;

R₁ is selected from the group consisting of -(CH₂)-(2-cyano)phenyl, -(CH₂)-(3-cyano)phenyl, -(CH₂)-(2-hydroxy)phenyl, -(CH₂)-(3-hydroxy)phenyl, -(CH₂)-(2-alkenyl)phenyl, -(CH₂)-(3-alkenyl)phenyl, -(CH₂)-(2-alkynyl)phenyl, -(CH₂)-(3-alkynyl)phenyl, -(CH₂)-(2-nitro)phenyl, -(CH₂)-(3-nitro)phenyl, -(CH₂)-(2-carboxy)phenyl, -(CH₂)-(3-carboxy)phenyl, -(CH₂)-(2-carboxamido)phenyl, -(CH₂)-(3-carboxamido)phenyl, -(CH₂)-(2-sulfonamido)phenyl, -(CH₂)-(3-sulfonamido)phenyl, -(CH₂)-(2-tetrazolyl)phenyl, -(CH₂)-(3-tetrazolyl)phenyl, -(CH₂)-(2-aminomethyl)phenyl, -(CH₂)-(3-aminomethyl)phenyl, -(CH₂)-(2-amino)phenyl, -(CH₂)-(3-

amino)phenyl, $-(CH_2)-(2\text{-hydroxymethyl})phenyl$, $-(CH_2)-(3\text{-hydroxymethyl})phenyl$, $-(CH_2)-(2\text{-phenyl})phenyl$, $-(CH_2)-(3\text{-phenyl})phenyl$, $-(CH_2)-(2\text{-CONH}_2)phenyl$, $-(CH_2)-(3\text{-CONH}_2)phenyl$, $-(CH_2)-(2\text{-CONH}(C_{1-7})alkyl)phenyl$, $-(CH_2)-(3\text{-CONH}(C_{1-7})alkyl)phenyl$, $-(CH_2)-(2\text{-CO}_2(C_{1-7})alkyl)phenyl$, $-(CH_2)-(3\text{-CO}_2(C_{1-7})alkyl)phenyl$, $-CH_2-NH_2$, $-CH_2-OH$, $-CH_2-(C_{3-7})alkyl$, $-CH_2\text{-alkene}$, $-CH_2\text{-alkyne}$, $-CH_2\text{-CCH}$, $-CH_2-(C_{3-7})cycloalkyl$, and $-CH_2\text{-aryl}$, each substituted or unsubstituted; and

R_2 is selected from the group consisting of 3-amino-piperidin-1-yl, 3-aminomethyl-pyrrolidin-1-yl, azetidin-1-yl, 3-aminoazetidin-1-yl, pyrrolidin-1-yl, 3-aminocyclopent-1-yl, 3-aminomethylcyclopent-1-yl, 3-aminomethylcyclohex-1-yl, hexahydroazepin-1-yl, 3-aminohexahydroazepin-1-yl, 3-amino-cyclohex-1-yl, piperazin-1-yl, homopiperazin-1-yl, 3-amino-pyrrolidin-1-yl, and R-3-aminopiperidin-1-yl, each substituted or unsubstituted.

[0118] In yet another variation,

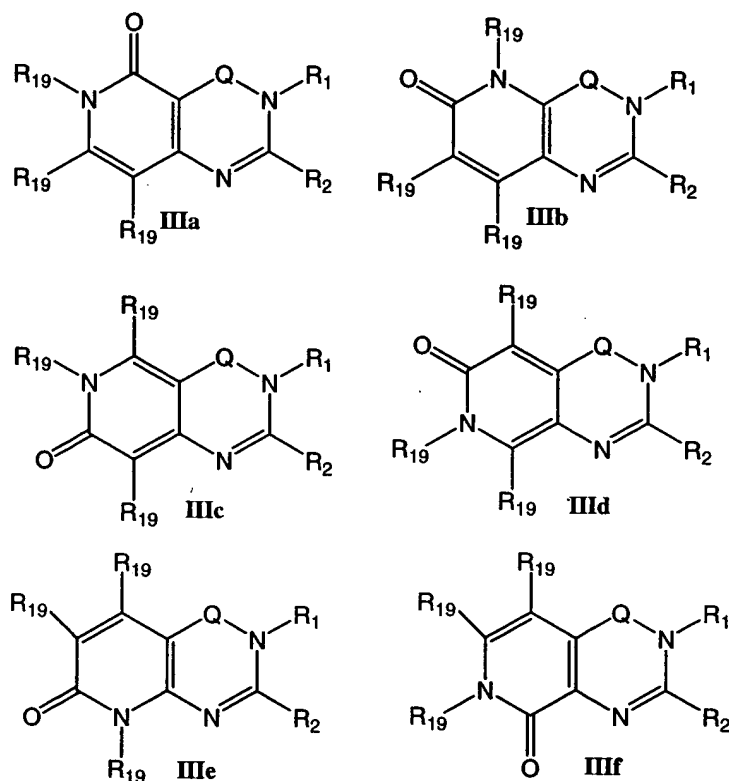
K is CR_{12} , where R_{12} is independently selected from the group consisting of halo, perhalo(C_{1-10})alkyl, CF_3 , cyano, nitro, alkyl, aryloxy, heteroaryloxy, amino, and alkoxy, each substituted or unsubstituted;

R_1 is selected from the group consisting of $-(CH_2)-(2\text{-cyano})phenyl$, $-(CH_2)-(3\text{-cyano})phenyl$, $-(CH_2)-(2\text{-hydroxy})phenyl$, $-(CH_2)-(3\text{-hydroxy})phenyl$, $-(CH_2)-(2\text{-alkenyl})phenyl$, $-(CH_2)-(3\text{-alkenyl})phenyl$, $-(CH_2)-(2\text{-alkynyl})phenyl$, $-(CH_2)-(3\text{-alkynyl})phenyl$, $-(CH_2)-(2\text{-nitro})phenyl$, $-(CH_2)-(3\text{-nitro})phenyl$, $-(CH_2)-(2\text{-carboxy})phenyl$, $-(CH_2)-(3\text{-carboxy})phenyl$, $-(CH_2)-(2\text{-carboxamido})phenyl$, $-(CH_2)-(3\text{-carboxamido})phenyl$, $-(CH_2)-(2\text{-sulfonamido})phenyl$, $-(CH_2)-(3\text{-sulfonamido})phenyl$, $-(CH_2)-(2\text{-tetrazolyl})phenyl$, $-(CH_2)-(3\text{-tetrazolyl})phenyl$, $-(CH_2)-(2\text{-aminomethyl})phenyl$, $-(CH_2)-(3\text{-aminomethyl})phenyl$, $-(CH_2)-(2\text{-amino})phenyl$, $-(CH_2)-(3\text{-amino})phenyl$, $-(CH_2)-(2\text{-hydroxymethyl})phenyl$, $-(CH_2)-(3\text{-hydroxymethyl})phenyl$, $-(CH_2)-(2\text{-phenyl})phenyl$, $-(CH_2)-(3\text{-phenyl})phenyl$, $-(CH_2)-(2\text{-CONH}_2)phenyl$, $-(CH_2)-(3\text{-CONH}_2)phenyl$, $-(CH_2)-(2\text{-CONH}(C_{1-7})alkyl)phenyl$, $-(CH_2)-(3\text{-CONH}(C_{1-7})alkyl)phenyl$, $-(CH_2)-(2\text{-CO}_2(C_{1-7})alkyl)phenyl$, $-(CH_2)-(3\text{-CO}_2(C_{1-7})alkyl)phenyl$, $-CH_2-NH_2$, $-CH_2-OH$, $-CH_2-(C_{3-7})alkyl$, $-CH_2\text{-alkene}$, $-CH_2\text{-alkyne}$, $-CH_2\text{-CCH}$, $-CH_2-(C_{3-7})cycloalkyl$, and $-CH_2\text{-aryl}$, each substituted or unsubstituted; and

R_2 is selected from the group consisting of 3-amino-piperidin-1-yl, 3-aminomethyl-pyrrolidin-1-yl, azetidin-1-yl, 3-aminoazetidin-1-yl, pyrrolidin-1-yl, 3-aminocyclopent-1-yl, 3-

aminomethylcyclopent-1-yl, 3-aminomethylcyclohex-1-yl, hexahydroazepin-1-yl, 3-aminohexahydroazepin-1-yl, 3-amino-cyclohex-1-yl, piperazin-1-yl, homopiperazin-1-yl, 3-aminopyrrolidin-1-yl, and R-3-aminopiperidin-1-yl, each substituted or unsubstituted.

[0119] In another embodiment, DPP-IV inhibitors of the present invention comprise a member selected from the group consisting of Formulae IIIa, IIIb, IIIc, IIId, IIIe and IIIf:



wherein

Q is selected from the group consisting of CO , SO , SO_2 , or $C=NR_9$;

R_1 is hydrogen or is selected from the group consisting of (C_{1-10}) alkyl, (C_{3-12}) cycloalkyl, (C_{3-12}) cycloalkyl (C_{1-5}) alkyl, hetero (C_{3-12}) cycloalkyl, aryl (C_{1-10}) alkyl, (C_{9-12}) bicycloaryl, hetero (C_{4-12}) bicycloaryl, carbonyl (C_{1-3}) alkyl, thiocarbonyl (C_{1-3}) alkyl, sulfonyl (C_{1-3}) alkyl, sulfinyl (C_{1-3}) alkyl, imino (C_{1-3}) alkyl, amino, cyano, aryl, heteroaryl, hydroxy, alkoxy, aryloxy, heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted;

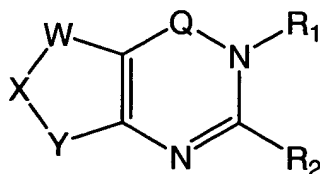
R_2 is selected from the group consisting of halo, perhalo (C_{1-10}) alkyl, amino, cyano, thio, (C_{1-10}) alkyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, carbonyl (C_{1-3}) alkyl, thiocarbonyl

(C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, hydroxy, alkoxy, aryloxy, heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, and a substituted or unsubstituted 4, 5, 6 or 7 membered ring;

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and

each R₁₉ is independently selected from the group consisting of hydrogen, halo, perhalo(C₁₋₁₀)alkyl, CF₃, cyano, nitro, alkyl, alkene, alkyne, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, with the proviso that R₁₉ is not alkylthio, arylthio, halo, cyano, nitro, and thio in the case where the ring atom to which R₁₉ is bound is nitrogen.

[0120] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula IV:



IV

wherein

Q is selected from the group consisting of CO, SO, SO₂, or C=NR₉;

W, X, and Y are each independently selected from the group of moieties where the ring atom is either C, N, O or S;

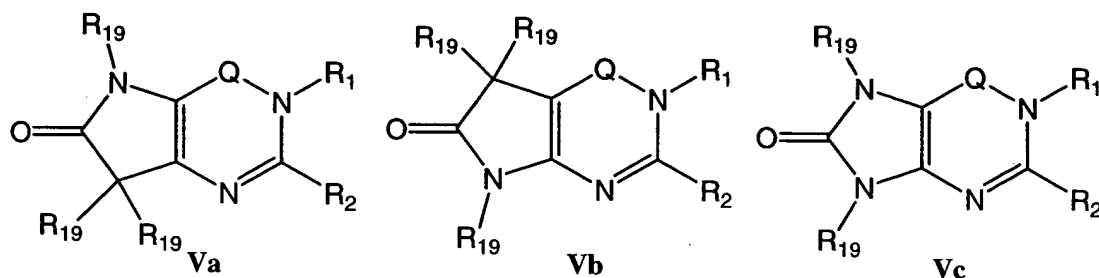
R₁ is hydrogen or is selected from the group consisting of (C₁₋₁₀)alkyl, (C₃₋₁₂)cycloalkyl, (C₃₋₁₂)cycloalkyl(C₁₋₅)alkyl, hetero(C₃₋₁₂)cycloalkyl, aryl(C₁₋₁₀)alkyl, (C₉₋₁₂)bicycloaryl, hetero(C₄₋₁₂)bicycloaryl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, amino, cyano, aryl, heteroaryl, hydroxy, alkoxy, aryloxy,

heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted;

R₂ is selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, amino, cyano, thio, (C₁₋₁₀)alkyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, hydroxy, alkoxy, aryloxy, heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, and a substituted or unsubstituted 4, 5, 6 or 7 membered ring; and

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0121] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae Va, Vb or Vc:



wherein

Q is selected from the group consisting of CO, SO, SO₂, or C=NR₉;

R₁ is hydrogen or is selected from the group consisting of (C₁₋₁₀)alkyl, (C₃₋₁₂)cycloalkyl, (C₃₋₁₂)cycloalkyl(C₁₋₅)alkyl, hetero(C₃₋₁₂)cycloalkyl, aryl(C₁₋₁₀)alkyl, (C₉₋₁₂)bicycloaryl, hetero(C₄₋₁₂)bicycloaryl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, amino, cyano, aryl, heteroaryl, hydroxy, alkoxy, aryloxy, heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted;

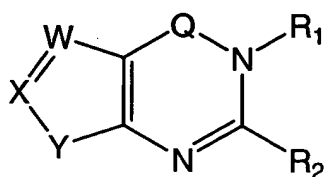
R₂ is selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, amino, cyano, thio, (C₁₋₁₀)alkyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, hydroxy, alkoxy, aryloxy,

heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, and a substituted or unsubstituted 4, 5, 6 or 7 membered ring;

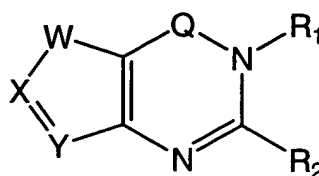
R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and

each R₁₉ is independently selected from the group consisting of hydrogen, halo, perhalo(C₁₋₁₀)alkyl, CF₃, cyano, nitro, alkyl, alkene, alkyne, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, with the proviso that R₁₉ is not alkylthio, arylthio, halo, cyano, nitro, and thio in the case where the ring atom to which R₁₉ is bound is nitrogen.

[0122] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula VIa or Formula VIb:



VIa



VIb

wherein

Q is selected from the group consisting of CO, SO, SO₂, or C=NR₉;

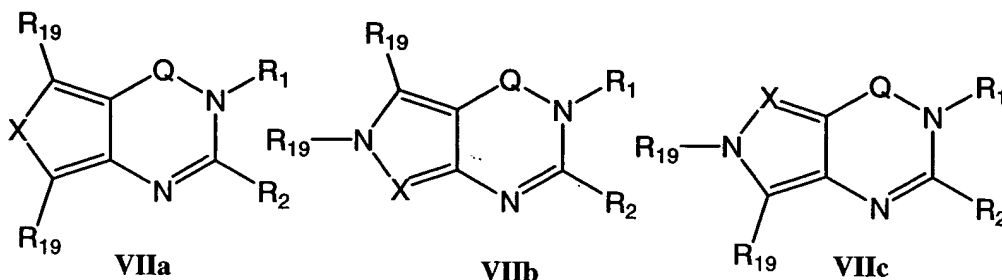
W, X, and Y are each independently selected from the group of moieties where the ring atom is either C, N, O or S;

R₁ is hydrogen or is selected from the group consisting of (C₁₋₁₀)alkyl, (C₃₋₁₂)cycloalkyl, (C₃₋₁₂)cycloalkyl(C₁₋₅)alkyl, hetero(C₃₋₁₂)cycloalkyl, aryl(C₁₋₁₀)alkyl, (C₉₋₁₂)bicycloaryl, hetero(C₄₋₁₂)bicycloaryl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, amino, cyano, aryl, heteroaryl, hydroxy, alkoxy, aryloxy, heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted;

R₂ is selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, amino, cyano, thio, (C₁₋₁₀)alkyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, hydroxy, alkoxy, aryloxy, heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, and a substituted or unsubstituted 4, 5, 6 or 7 membered ring; and

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0123] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae VIIa, VIIb, or VIIc:



wherein

Q is selected from the group consisting of CO, SO, SO₂, or C=NR₉;

X is selected from the group of moieties where the ring atom is either C, N, O or S in Formula VIIa, or X is selected from the group of moieties where the ring atom is either C or N in Formula VIIb or Formula VIIc;

R₁ is hydrogen or is selected from the group consisting of (C₁₋₁₀)alkyl, (C₃₋₁₂)cycloalkyl, (C₃₋₁₂)cycloalkyl(C₁₋₅)alkyl, hetero(C₃₋₁₂)cycloalkyl, aryl(C₁₋₁₀)alkyl, C₉₋₁₂bicycloaryl, hetero(C₄₋₁₂)bicycloaryl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, amino, cyano, aryl, heteroaryl, hydroxy, alkoxy, aryloxy, heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted;

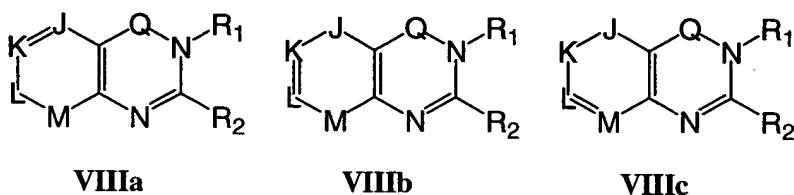
R₂ is selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, amino, cyano, thio, (C₁₋₁₀)alkyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, hydroxy, alkoxy, aryloxy,

heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, and a substituted or unsubstituted 4, 5, 6 or 7 membered ring;

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and

each R₁₉ is independently selected from the group consisting of hydrogen, halo, perhalo(C₁₋₁₀)alkyl, CF₃, cyano, nitro, alkyl, alkene, alkyne, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, with the proviso that R₁₉ is not alkylthio, arylthio, halo, cyano, nitro, and thio in the case where the ring atom to which R₁₉ is bound is nitrogen.

[0124] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae VIIIa VIIIb and VIIIc:



wherein

Q is selected from the group consisting of CO, SO, SO₂, or C=NR₉;

J, K, L, and M are each independently selected from the group of moieties where the ring atom is either C, N, O or S;

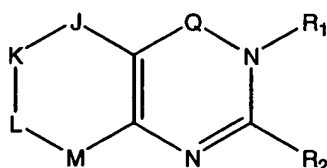
R₁ is hydrogen or is selected from the group consisting of (C₁₋₁₀)alkyl, (C₃₋₁₂)cycloalkyl, (C₃₋₁₂)cycloalkyl(C₁₋₅)alkyl, hetero(C₃₋₁₂)cycloalkyl, aryl(C₁₋₁₀)alkyl, (C₉₋₁₂)bicycloaryl, hetero(C₄₋₁₂)bicycloaryl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, amino, cyano, aryl, heteroaryl, hydroxy, alkoxy, aryloxy, heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted;

R₂ is selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, amino, cyano, thio, (C₁₋₁₀)alkyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, hydroxy, alkoxy, aryloxy,

heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, and a substituted or unsubstituted 4, 5, 6 or 7 membered ring; and

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0125] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula IX:



IX

wherein

Q is selected from the group consisting of CO, SO, SO₂, or C=NR₉;

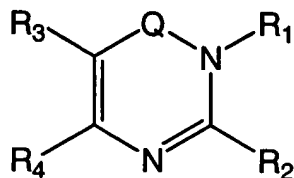
J, K, L, and M are each independently selected from the group of moieties where the ring atom is either C, N, O or S;

R₁ is hydrogen or is selected from the group consisting of (C₁₋₁₀)alkyl, (C₃₋₁₂)cycloalkyl, (C₃₋₁₂)cycloalkyl(C₁₋₅)alkyl, hetero(C₃₋₁₂)cycloalkyl, aryl(C₁₋₁₀)alkyl, (C₉₋₁₂)bicycloaryl, hetero(C₄₋₁₂)bicycloaryl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, amino, cyano, aryl, heteroaryl, hydroxy, alkoxy, aryloxy, heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted;

R₂ is selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, amino, cyano, thio, (C₁₋₁₀)alkyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, hydroxy, alkoxy, aryloxy, heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, and a substituted or unsubstituted 4, 5, 6 or 7 membered ring; and

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0126] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula X:



X

wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

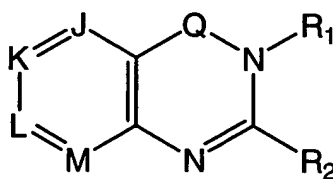
R₁ is -ZR_m, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R₁ is attached, and R_m is selected from the group consisting of a substituted or unsubstituted (C₃₋₇)cycloalkyl and aryl;

R₂ is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring;

R₃ and R₄ are taken together to form a substituted or unsubstituted 5 or 6 membered ring;
and

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0127] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula XI:



XI

wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

J, K, L, and M are each independently selected from the group of CR₁₂ and N;

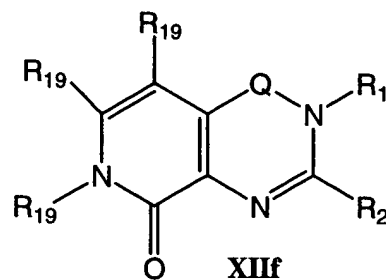
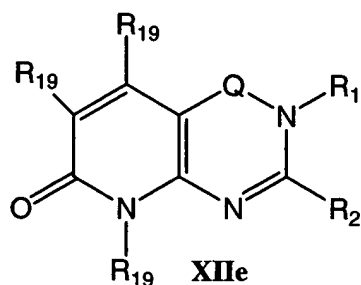
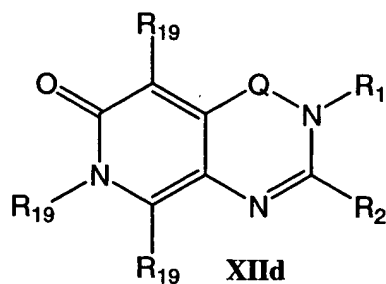
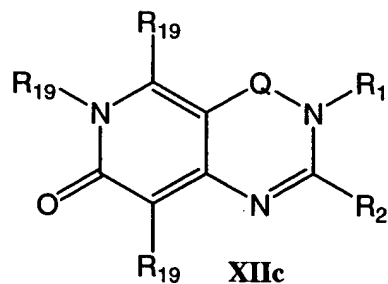
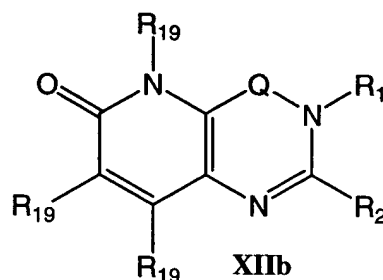
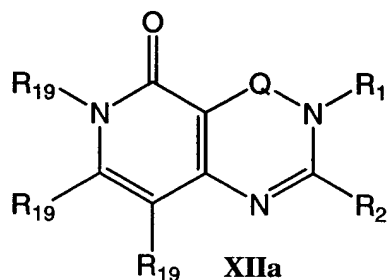
R₁ is -ZR_m, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R₁ is attached, and R_m is selected from the group consisting of a substituted or unsubstituted (C₃₋₇)cycloalkyl and aryl;

R_2 is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring;

R_9 is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and

each R_{12} is hydrogen or is independently selected from the group consisting of halo, perhalo(C_{1-10})alkyl, CF_3 , alkyl, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, cyano, nitro, alkoxy, a carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted.

[0128] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae XIIa, XIIb, XIIc, XIId, XIIe, and XIIf:



wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

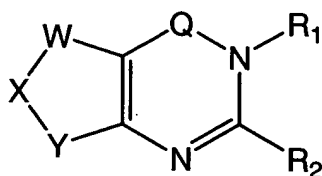
R₁ is -ZR_m, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R₁ is attached, and R_m is selected from the group consisting of a substituted or unsubstituted (C₃₋₇)cycloalkyl and aryl;

R₂ is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring;

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and

each R₁₉ is independently selected from the group consisting of hydrogen, halo, perhalo(C₁₋₁₀)alkyl, CF₃, cyano, nitro, alkyl, alkene, alkyne, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, with the proviso that R₁₉ is not alkylthio, arylthio, halo, cyano, nitro, and thio in the case where the ring atom to which R₁₉ is bound is nitrogen.

[0129] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula XIII:



XIII

wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

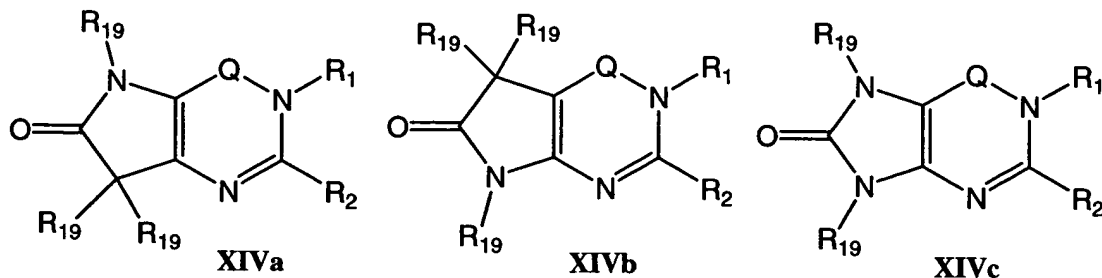
W, X, and Y are each independently selected from the group of moieties where the ring atom is either C, N, O or S;

R₁ is -ZR_m, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R₁ is attached, and R_m is selected from the group consisting of a substituted or unsubstituted (C₃₋₇)cycloalkyl and aryl;

R₂ is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring; and

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0130] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae XIVa, XIVb, and XIVc:



wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

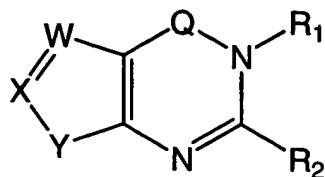
R₁ is -ZR_m, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R₁ is attached, and R_m is selected from the group consisting of a substituted or unsubstituted (C₃₋₇)cycloalkyl and aryl;

R₂ is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring;

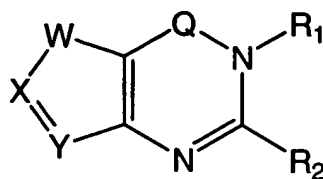
R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and

each R₁₉ is independently selected from the group consisting of hydrogen, halo, perhalo(C₁₋₁₀)alkyl, CF₃, cyano, nitro, alkyl, alkene, alkyne, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, with the proviso that R₁₉ is not alkylthio, arylthio, halo, cyano, nitro, and thio in the case where the ring atom to which R₁₉ is bound is nitrogen.

[0131] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae XVa and XVb:



XVa



XVb

wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

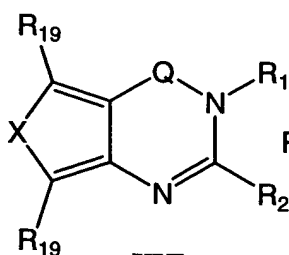
W, X, and Y are each independently selected from the group of moieties where the ring atom is either C, N, O or S;

R₁ is -ZR_m, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R₁ is attached, and R_m is selected from the group consisting of a substituted or unsubstituted (C₃₋₇)cycloalkyl and aryl;

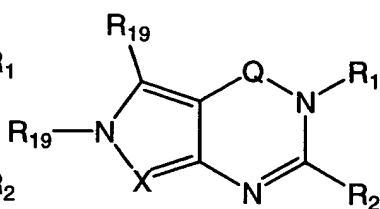
R₂ is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring; and

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

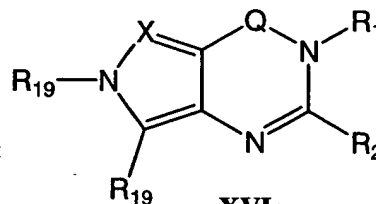
[0132] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae XVIa, XVIb, and XVIc:



XVIa



XVIb



XVIc

wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

X is selected from the group of moieties where the ring atom is either C, N, O or S in Formula XVIa, or X is selected from the group of moieties where the ring atom is either C or N in Formula XVIb or Formula XVIc;

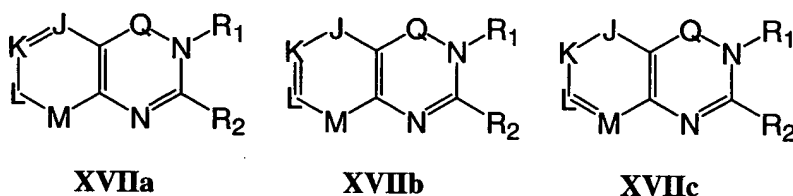
R_1 is $-ZR_m$, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R_1 is attached, and R_m is selected from the group consisting of a substituted or unsubstituted (C_{3-7}) cycloalkyl and aryl;

R_2 is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring;

R_9 is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and

each R_{19} is independently selected from the group consisting of hydrogen, halo, perhalo(C_{1-10})alkyl, CF_3 , cyano, nitro, alkyl, alkene, alkyne, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, with the proviso that R_{19} is not alkylthio, arylthio, halo, cyano, nitro, and thio in the case where the ring atom to which R_{19} is bound is nitrogen.

[0133] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae XVIIa, XVIIb, and XVIIc:



wherein

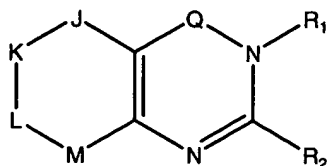
Q is selected from the group consisting of CO, CS, SO, SO_2 , or $C=NR_9$;

J, K, L, and M are each independently selected from the group of moieties where the ring atom is either C, N, O or S;

R_1 is $-ZR_m$, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R_1 is attached, and R_m is selected from the group consisting of a substituted or unsubstituted (C_{3-7}) cycloalkyl and aryl; and

R_2 is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring.

[0134] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula XVIII:



XVIII

wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

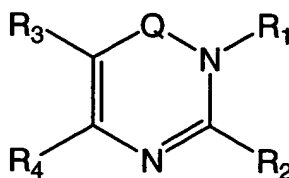
J, K, L, and M are each independently selected from the group of moieties where the ring atom is either C, N, O or S;

R₁ is -ZR_m, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R₁ is attached, and R_m is selected from the group consisting of a substituted or unsubstituted (C₃₋₇)cycloalkyl and aryl;

R₂ is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring; and

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0135] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula XIX:



XIX

wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

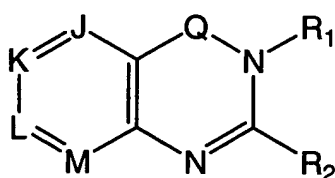
R₁ is -ZR_m, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R₁ is attached, and -R_m is selected from the group consisting of a substituted or unsubstituted (C₃₋₇)cycloalkyl and aryl;

R_2 is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R_2 is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein;

R_3 and R_4 are taken together to form a substituted or unsubstituted 5 or 6 membered ring; and

R_9 is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0136] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula XX:



XX

wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

J, K, L, and M are each independently selected from the group of CR₁₂ and N;

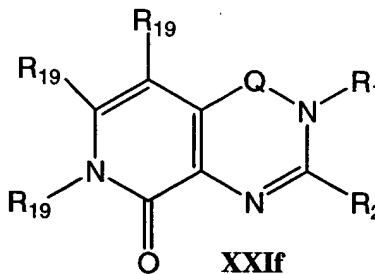
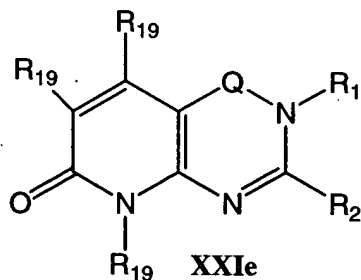
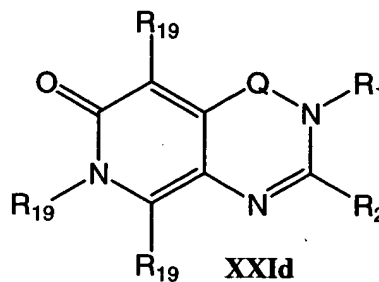
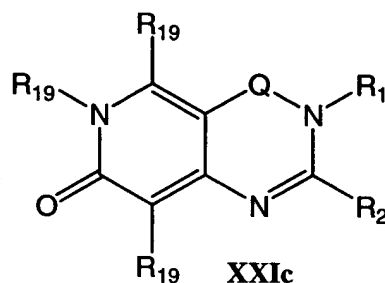
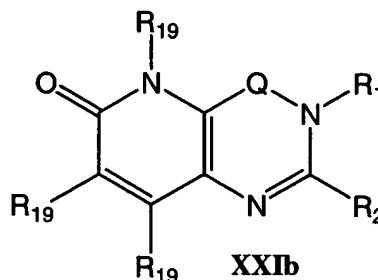
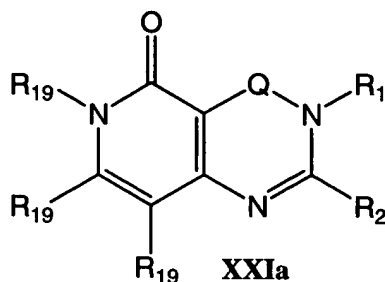
R_1 is -ZR_m, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R_1 is attached, and -R_m is selected from the group consisting of a substituted or unsubstituted (C₃₋₇)cycloalkyl and aryl;

R_2 is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R_2 is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein;

R_9 is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and

each R₁₂ is hydrogen or is independently selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, CF₃, alkyl, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, cyano, nitro, alkoxy, a carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted.

[0137] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae XXIa, XXIb, XXIc, XXId, XXIf, and XXIf:



wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

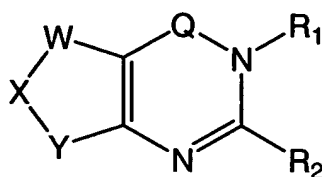
R₁ is -ZR_m, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R₁ is attached, and -R_m is selected from the group consisting of a substituted or unsubstituted (C₃₋₇)cycloalkyl and aryl;

R₂ is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R₂ is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein;

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and

each R_{19} is independently selected from the group consisting of hydrogen, halo, perhalo(C_{1-10})alkyl, CF_3 , cyano, nitro, alkyl, alkene, alkyne, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, with the proviso that R_{19} is not alkylthio, arylthio, halo, cyano, nitro, and thio in the case where the ring atom to which R_{19} is bound is nitrogen.

[0138] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula XXII:



XXII

wherein

Q is selected from the group consisting of CO, CS, SO, SO_2 , or $C=NR_9$;

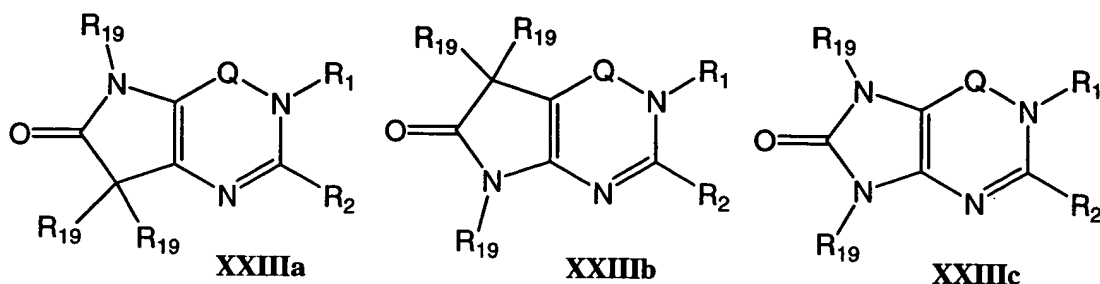
W, X, and Y are each independently selected from the group of moieties where the ring atom is either C, N, O or S;

R_1 is $-ZR_m$, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R_1 is attached, and $-R_m$ is selected from the group consisting of a substituted or unsubstituted (C_{3-7})cycloalkyl and aryl;

R_2 is $-UV$, where U is a moiety providing 1-6 atom separation between V and the ring to which R_2 is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein; and

R_9 is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0139] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae XXIIIa, XXIIIb, and XXIIIc:



wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

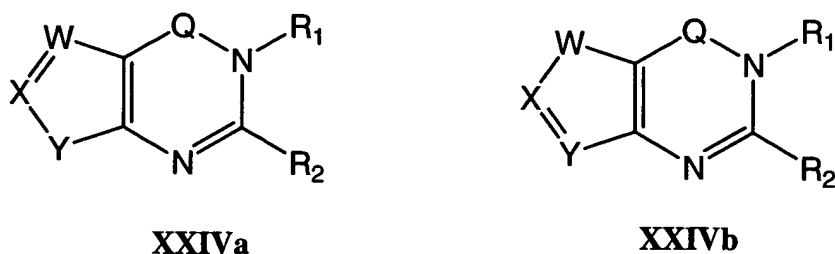
R_1 is $-ZR_m$, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R_1 is attached, and $-R_m$ is selected from the group consisting of a substituted or unsubstituted (C_{3-7}) cycloalkyl and aryl;

R₂ is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R₂ is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein;

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and

each R₁₉ is independently selected from the group consisting of hydrogen, halo, perhalo(C₁₋₁₀)alkyl, CF₃, cyano, nitro, alkyl, alkene, alkyne, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, with the proviso that R₁₉ is not alkylthio, arylthio, halo, cyano, nitro, and thio in the case where the ring atom to which R₁₉ is bound is nitrogen.

[0140] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae XXIVa and XXIVb:



wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

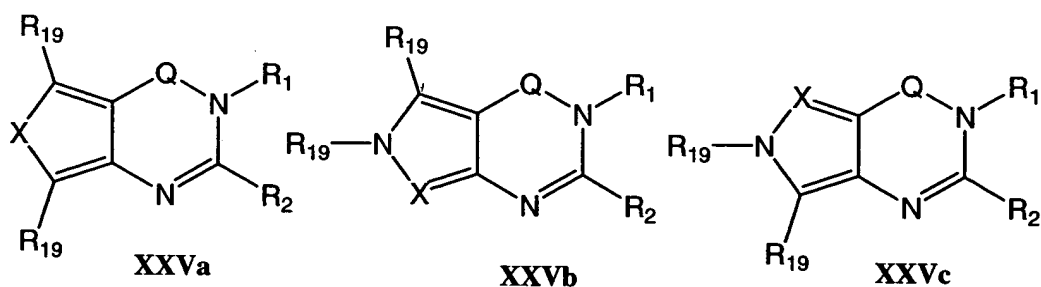
W, X, and Y are each independently selected from the group of moieties where the ring atom is either C, N, O or S;

R₁ is -ZR_m, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R₁ is attached, and -R_m is selected from the group consisting of a substituted or unsubstituted (C₃₋₇)cycloalkyl and aryl;

R₂ is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R₂ is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein; and

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0141] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae XXVa, XXVb, and XXVc:



wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

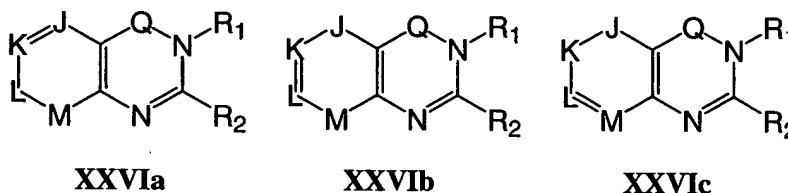
X is selected from the group of moieties where the ring atom is either C, N, O or S in Formula XXVa, or X is selected from the group of moieties where the ring atom is either C or N in Formula XXVb or Formula XXVc;

R₁ is -ZR_m, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R₁ is attached, and -R_m is selected from the group consisting of a substituted or unsubstituted (C₃₋₇)cycloalkyl and aryl;

R_2 is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R_2 is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein;

R_9 is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and each R_{19} is independently selected from the group consisting of hydrogen, halo, perhalo(C_{1-10})alkyl, CF_3 , cyano, nitro, alkyl, alkene, alkyne, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, with the proviso that R_{19} is not alkylthio, arylthio, halo, cyano, nitro, and thio in the case where the ring atom to which R_{19} is bound is nitrogen.

[0142] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae XXVIa, XXVIb, and XXVIc:



wherein

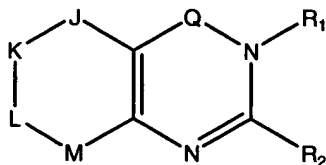
Q is selected from the group consisting of CO, CS, SO, SO_2 , or $C=NR_9$;

J, K, L, and M are each independently selected from the group of moieties where the ring atom is either C, N, O or S;

R_1 is $-ZR_m$, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R_1 is attached, and $-R_m$ is selected from the group consisting of a substituted or unsubstituted (C_{3-7})cycloalkyl and aryl; and

R_2 is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R_2 is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein.

[0143] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula XXVII:



XXVII

wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

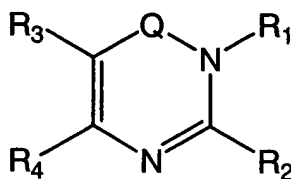
J, K, L, and M are each independently selected from the group of moieties where the ring atom is either C, N, O or S;

R₁ is -ZR_m, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R₁ is attached, and -R_m is selected from the group consisting of a substituted or unsubstituted (C₃₋₇)cycloalkyl and aryl;

R₂ is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R₂ is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein; and

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0144] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula XXVIII:



XXVIII

wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

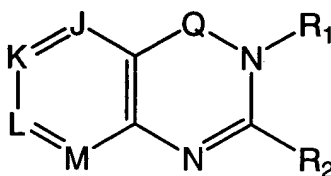
R₁ is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring;

R₂ is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R₂ is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein;

R₃ and R₄ are taken together to form a substituted or unsubstituted 5 or 6 membered ring; and

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0145] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula XXIX:



XXIX

wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

J, K, L, and M are each independently selected from the group of CR₁₂ and N;

R₁ is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring;

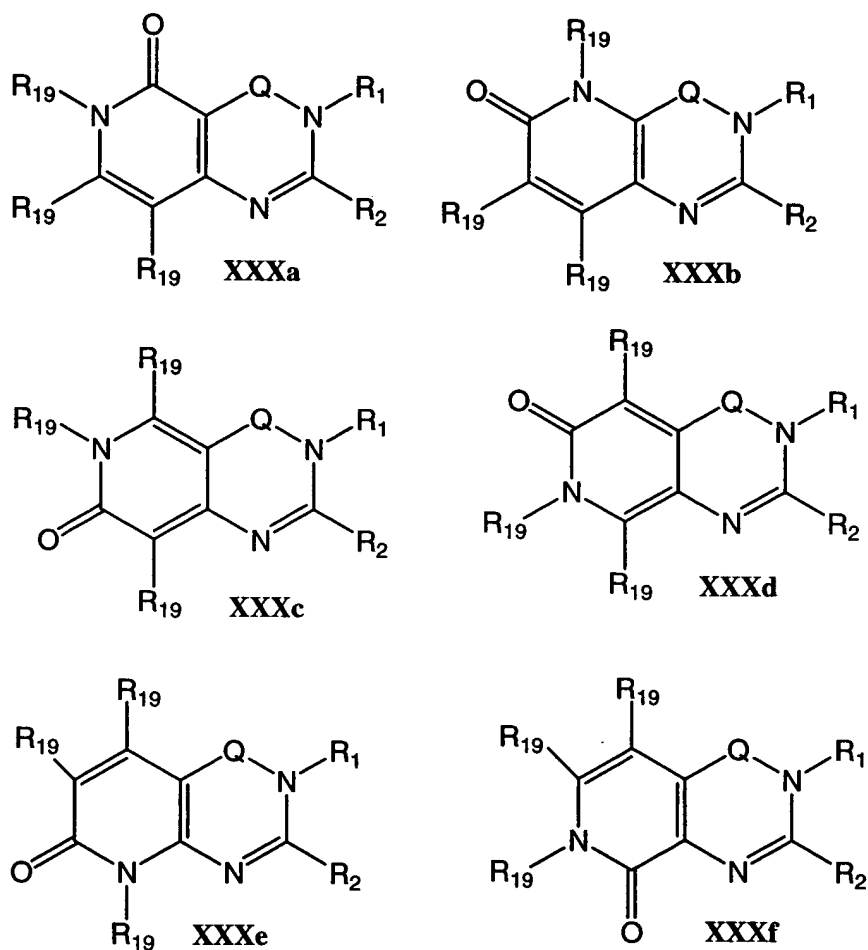
R₂ is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R₂ is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein;

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and

each R₁₂ is hydrogen or is independently selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, CF₃, alkyl, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl,

amino, thio, cyano, nitro, alkoxy, a carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted.

[0146] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae XXXa, XXXb, XXXc, XXXd, XXXe, and XXXf:



wherein

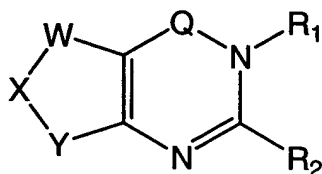
Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

R₁ is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring;

R₂ is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R₂ is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein;

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and each R₁₉ is independently selected from the group consisting of hydrogen, halo, perhalo(C₁₋₁₀)alkyl, CF₃, cyano, nitro, alkyl, alkene, alkyne, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, with the proviso that R₁₉ is not alkylthio, arylthio, halo, cyano, nitro, and thio in the case where the ring atom to which R₁₉ is bound is nitrogen.

[0147] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula XXXI:



XXXI

wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

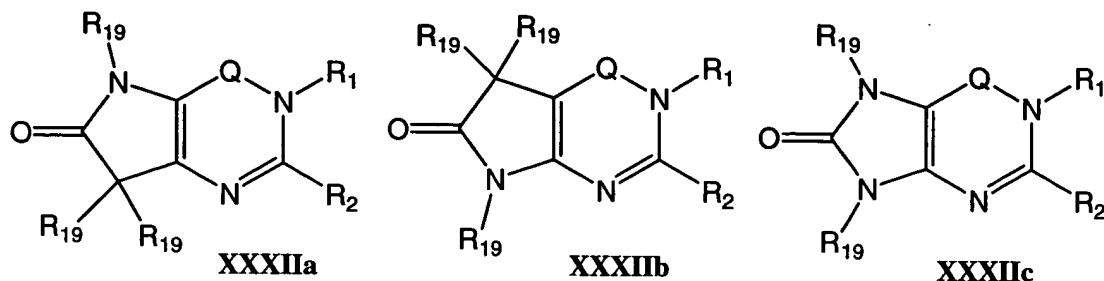
W, X, and Y are each independently selected from the group of moieties where the ring atom is either C, N, O or S;

R₁ is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring;

R₂ is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R₂ is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein; and

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0148] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae XXXIIa, XXXIIb, and XXXIIc:



wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

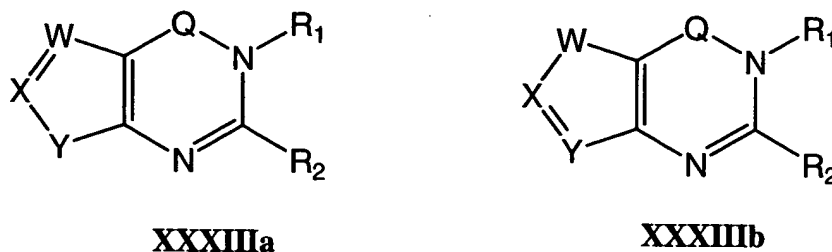
R₁ is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring;

R₂ is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R₂ is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein;

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and

each R₁₉ is independently selected from the group consisting of hydrogen, halo, perhalo(C₁₋₁₀)alkyl, CF₃, cyano, nitro, alkyl, alkene, alkyne, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, with the proviso that R₁₉ is not alkylthio, arylthio, halo, cyano, nitro, and thio in the case where the ring atom to which R₁₉ is bound is nitrogen.

[0149] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae XXXIIIa and XXXIIIb:



wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

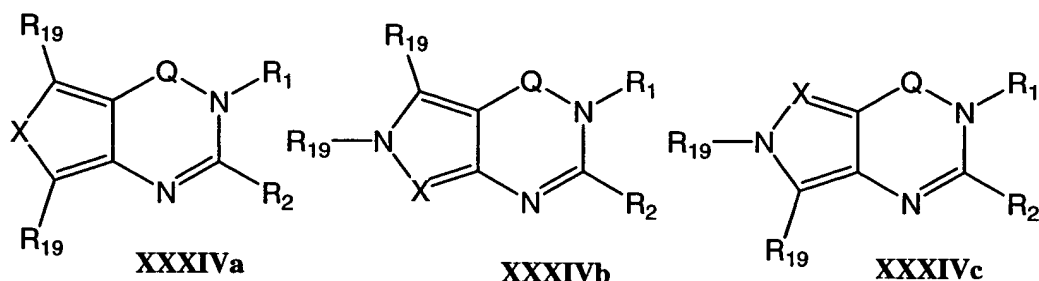
W, X, and Y are each independently selected from the group of moieties where the ring atom is either C, N, O or S;

R₁ is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring;

R₂ is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R₂ is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein; and

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0150] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae XXXIVa, XXXIVb, and XXXIVc:



wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

X is selected from the group of moieties where the ring atom is either C, N, O or S in Formula XXXIVa, or X is selected from the group of moieties where the ring atom is either C or N in Formula XXXIVb or Formula XXXIVc;

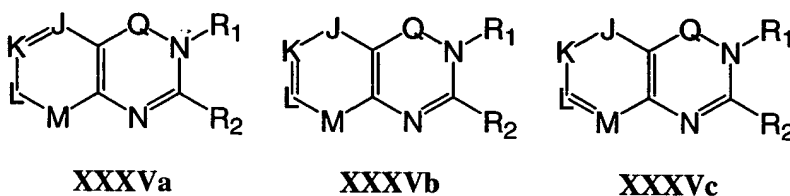
R₁ is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring;

R₂ is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R₂ is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein;

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and

each R₁₉ is independently selected from the group consisting of hydrogen, halo, perhalo(C₁₋₁₀)alkyl, CF₃, cyano, nitro, alkyl, alkene, alkyne, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, with the proviso that R₁₉ is not alkylthio, arylthio, halo, cyano, nitro, and thio in the case where the ring atom to which R₁₉ is bound is nitrogen.

[0151] In another embodiment, DPP-IV inhibitors of the present invention comprise Formulae XXXVa, XXXVb, and XXXVc:



wherein

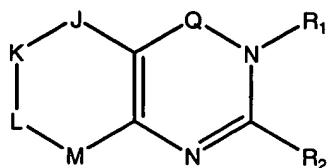
Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

J, K, L, and M are each independently selected from the group of moieties where the ring atom is either C, N, O or S;

R₁ is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring; and

R₂ is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R₂ is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein.

[0152] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula XXXVI:



XXXVI

wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

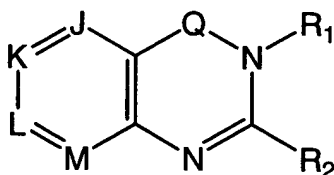
J, K, L, and M are each independently selected from the group of moieties where the ring atom is either C, N, O or S;

R₁ is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring;

R₂ is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R₂ is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein; and

R₉ is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted.

[0153] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula XXXVII:



XXXVII

wherein

Q is selected from the group consisting of CO, CS, SO, SO₂, or C=NR₉;

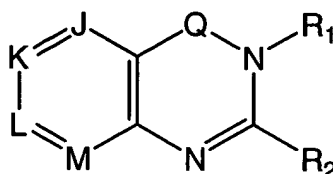
J, K, L, and M are each independently selected from the group of CR₁₂ and N, provided that at least one of K and L is CR₁₂ where R₁₂ is not hydrogen;

R₁ is -ZR_m, where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R₁ is attached, and R_m is selected from the group consisting of a substituted or unsubstituted (C₃₋₇)cycloalkyl and aryl;

R_2 is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R_2 is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein;

R_9 is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and each R_{12} is hydrogen or is independently selected from the group consisting of halo, perhalo(C_{1-10})alkyl, CF_3 , alkyl, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, cyano, nitro, alkoxy, a carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted.

[0154] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula XXXVIII:



XXXVIII

wherein

Q is selected from the group consisting of CO, CS, SO, SO_2 , or $C=NR_9$;

J, K, L, and M are each independently selected from the group of CR_{12} and N, provided that at least one of K and L is CR_{12} where R_{12} is not hydrogen;

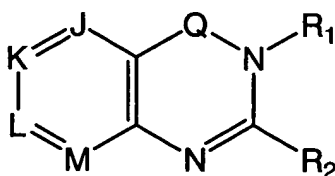
R_1 is - ZR_m , where Z is a moiety providing 1-6 atom separation between R_m and the ring to which R_1 is attached, and R_m is selected from the group consisting of a substituted or unsubstituted (C_{3-7})cycloalkyl and aryl;

R_2 is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring;

R_9 is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and

each R_{12} is hydrogen or is independently selected from the group consisting of halo, perhalo(C_{1-10})alkyl, CF_3 , alkyl, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, cyano, nitro, alkoxy, a carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted.

[0155] In another embodiment, DPP-IV inhibitors of the present invention comprise Formula XXXIX:



XXXIX

wherein

Q is selected from the group consisting of CO, CS, SO, SO_2 , or $C=NR_9$;

J, K, L, and M are each independently selected from the group of CR_{12} and N, provided that at least one of K and L is CR_{12} where R_{12} is not hydrogen;

R_1 is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring;

R_2 is -UV, where U is a moiety providing 1-6 atom separation between V and the ring to which R_2 is attached and V comprises a basic nitrogen atom that is capable of interacting with a carboxylic acid side chain of an active site residue of a protein; and

R_9 is hydrogen or is selected from the group consisting of alkyl, cycloalkyl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl, each substituted or unsubstituted; and each R_{12} is hydrogen or is independently selected from the group consisting of halo, perhalo(C_{1-10})alkyl, CF_3 , alkyl, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, cyano, nitro, alkoxy, a carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted.

Substituents R₃ and R₄:

[0156] In one variation of each of the above embodiments and variations comprising R₃ and R₄, R₃ and R₄ are taken together to form an unsubstituted or substituted 5 or 6 membered cycloalkyl or heterocycloalkyl ring. In another variation, R₃ and R₄ are taken together to form a substituted or unsubstituted phenyl ring. In yet another variation, R₃ and R₄ are taken together to form a substituted or unsubstituted heteroaryl ring. In still another variation, R₃ and R₄ are taken together to form a substituted or unsubstituted heteroaryl selected from the group consisting of substituted or unsubstituted furan, thiophene, pyrrole, pyrazole, triazole, isoxazole, oxazole, thiazole, isothiazole, oxadiazole, pyridine, pyridazine, pyrimidine, pyrazine, triazine, benzofuran, isobenzofuran, benzothiophene, isobenzothiophene, imidazole, benzimidazole, indole, isoindole, quinoline, isoquinoline, cinnoline, quinazoline, naphthyridine, pyridopyridine, quinoxaline, phthalazine, and benzothiazole.

[0157] In a further variation of each of the above embodiments and variations comprising R₃ and R₄, R₃ and R₄ are taken together to form a 5 or 6-membered ring where the ring comprises at least one CO group. In another variation of each of the above embodiments and variations comprising R₃ and R₄, R₃ and R₄ are taken together to form a 5 or 6-membered ring comprising of 1-3 nitrogen ring atoms. In yet another variation of each of the above embodiments and variations comprising R₃ and R₄, R₃ and R₄ are taken together to form a 5 or 6-membered ring where the ring comprises a sulfur atom. In one variation, the ring sulfur atom is in an oxidized form as SO or SO₂.

[0158] In particular variations, R₃ and R₄ are taken together to form a ring system such that the compound formed is selected from the group consisting of substituted or unsubstituted 4-oxo-4H-quinazoline, 3H-pyrido[2,3-d]pyrimidin-4-one, 3H-pyrido[3,2-d]pyrimidin-4-one, 3H-pyrido[3,4-d]pyrimidin-4-one and 3H-pyrido[4,3-d]pyrimidin-4-one.

[0159] In still another variation of each of the above embodiments and variations wherein R₃ and R₄ are taken together to form a ring, the ring formed by R₃ and R₄ comprises substituents that form a ring fused to the ring formed by R₃ and R₄. The fused ring may be further substituted or unsubstituted, and may be a saturated or unsaturated ring. In one variation, the fused ring is a heterocyclic ring.

[0160] In another variation, the 5 or 6 membered ring is further substituted such that a 3, 4, 5, 6 or 7 membered bridging ring is formed with the 5 or 6 membered ring. The 3, 4, 5, 6 or 7 membered

ring may be further substituted or unsubstituted, and may be a saturated or unsaturated ring. In another variation, the 3, 4, 5, 6 or 7 membered bridged ring may be a heterocyclic ring.

Substituents J, K, L, M:

[0161] In one variation, J, K, L and M each comprises a carbon ring atom. In another variation, J comprises a nitrogen ring atom. In another variation, K comprises a nitrogen ring atom. In another variation, L comprises a nitrogen ring atom. In another variation, M comprises a nitrogen ring atom.

[0162] In yet another variation, J and L each comprise a nitrogen ring atom or J and K each comprise a nitrogen ring atom. In another variation, K and L each comprise a nitrogen ring atom. In another variation, K and M each comprise a nitrogen ring atom. In yet another variation, J and M each comprise a nitrogen ring atom, or L and M each comprise a nitrogen ring atom.

[0163] In a further variation of each of the above embodiments and variations comprising J, K, L and M, at least one of J, K, L and M comprise a nitrogen ring atom. In yet another variation, at least two of J, K, L and M comprise a nitrogen ring atom. In another variation, at least three of J, K, L and M comprise a nitrogen ring atom. In still another variation of each of the above embodiments and variations comprising J, K, L and M, at least three of J, K, L and M comprise a nitrogen ring atom.

[0164] According to each of the above variations, the ring formed by J, K, L, and M may comprise substituents that form a ring fused or bridged (e.g., through available valencies) to the ring formed by J, K, L, and M. In particular with respect to the case of Formula VIIIb, J and M optionally form a fused or bridged ring relative to the ring formed by J, K, L, and M.

[0165] In another variation of each of the above embodiments and variations comprising K, K is CR₁₂, where R₁₂ is independently selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, CF₃, alkyl, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, cyano, nitro, alkoxy, a carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted.

[0166] In still another variation of each of the above embodiments and variations comprising K, K is CR₁₂, where R₁₂ is independently selected from the group consisting of halo,

perhalo(C₁₋₁₀)alkyl, CF₃, cyano, nitro, alkyl, aryloxy, heteroaryloxy, amino, and alkoxy, each substituted or unsubstituted.

[0167] In yet another variation of each of the above embodiments and variations comprising K, K is CR₁₂, where R₁₂ is independently selected from the group consisting of heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryl, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, thio, a carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted.

[0168] In a further variation of each of the above embodiments and variations comprising K, K is CR₁₂, where R₁₂ is independently selected from the group consisting of chloro, bromo, fluoro, iodo, methoxy, morpholin-4-yl, and pyrrolidin-1-yl, each substituted or unsubstituted.

[0169] In one variation of each of the above embodiments and variations comprising L, L comprises a nitrogen ring atom.

[0170] In another variation of each of the above embodiments and variations comprising L, L is CR₁₂, where R₁₂ is independently selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, CF₃, alkyl, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, cyano, nitro, alkoxy, a carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted.

[0171] In still another variation of each of the above embodiments and variations comprising L, L is CR₁₂, where R₁₂ is independently selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, CF₃, cyano, nitro, alkyl, aryloxy, heteroaryloxy, amino, morpholin-4-yl, and pyrrolidin-1-yl, and alkoxy, each substituted or unsubstituted.

[0172] In one variation of each of the above embodiments and variations comprising J, K, L and M, at least one of J, K, L and M is CO.

[0173] In another variation of each of the above embodiments and variations comprising J, K, L and M, at least one of J, K, L and M is SO.

[0174] In still another variation of each of the above embodiments and variations comprising J, K, L and M, at least one of J, K, L and M is SO₂.

[0175] In one variation of each of the above embodiments and variations comprising J and M, J and M form a bridged ring relative to the ring formed by J, K, L, and M

[0176] In one variation of each of the above embodiments and variations comprising K and L, K and L are independently CR₁₂, where R₁₂ is independently selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, CF₃, cyano, nitro, alkyl, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, a carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted.

[0177] In another variation of each of the above embodiments and variations comprising K and L,

K is CR₁₂, where R₁₂ is independently selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, CF₃, cyano, nitro, alkyl, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, a carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted; and

L is nitrogen.

[0178] In one variation of each of the above embodiments and variations comprising R₁₂, at least one R₁₂ is halogen.

[0179] In another variation of each of the above embodiments and variations comprising R₁₂, at least one R₁₂ is fluorine.

Substituents W, X, and Y

[0180] In one variation, at least one of W, X, and Y is CO. In another variation, at least one of W, X, and Y is SO. In another variation, at least one of W, X, and Y is SO₂. In one variation of each of the above embodiments and variations comprising W, W is selected from the group consisting of CO, SO or SO₂. In one variation of each of the above embodiments and variations comprising Y, Y is selected from the group consisting of CO, SO or SO₂.

[0181] In another variation, at least one of W, X, and Y comprises a ring nitrogen atom. In yet another variation, at least two of W, X, and Y comprises a ring nitrogen atom. In yet another variation, W comprises a ring nitrogen atom. In still variation, X comprises a ring nitrogen atom. In a further variation, Y comprises a ring nitrogen atom.

[0182] In another variation, W and Y are taken together to form a substituted or unsubstituted bridged ring relative to the ring formed by W, X and Y. In yet another variation, at least two (*i.e.*, two or three) of W, X, and Y are taken together to form a substituted or unsubstituted ring fused or bridged (*e.g.*, by substitution through available valencies) to the ring formed by W, X and Y.

[0183] In a further variation, W, X, and Y are selected such that the compound comprises a ring system selected from the group consisting of 4-oxo-4H-thieno[3,2-d]pyrimidine, 7-oxo-1,2,3,7-tetrahydro-8-thia-4,6-diaza-cyclopenta[a]indene, 7-methyl-6-oxo-6,7-dihydro-purine, and 6-oxo-6,9-dihydro-purine, each substituted or unsubstituted.

Substituent R₁:

[0184] In one variation, R₁ is selected from the group consisting of -NH₂, -NHCH₃, -N(CH₃)₂, -NHC₁₋₃-alkyl, and -N(C₁₋₃-alkyl)₂, each unsubstituted or substituted through available valencies. In another variation, R₁ is selected from the group consisting of a (C₁₋₃)alkyl; an amino, alkyl, or alkoxy carbonyl (C₁₋₃)alkyl; an amino, alkyl, or alkoxy thiocarbonyl (C₁₋₃)alkyl; an amino, alkyl, or alkoxy sulfonyl (C₁₋₃)alkyl; an amino, alkyl, or alkoxy sulfinyl (C₁₋₃)alkyl; an amino, alkyl, or alkoxy imino (C₁₋₃)alkyl; and an aryl (C₁₋₅)alkyl, each unsubstituted or substituted through available valencies.

[0185] In another variation, R₁ is selected from the group consisting of a (C₂₋₁₀)alkenyl; an amino, alkyl, or alkoxy carbonyl (C₁₋₃)alkenyl; an amino, alkyl, or alkoxy thiocarbonyl (C₁₋₃)alkenyl; an amino, alkyl, or alkoxy sulfonyl (C₁₋₃)alkenyl; an amino, alkyl, or alkoxy sulfinyl (C₁₋₃)alkenyl; an amino, alkyl, or alkoxy imino (C₁₋₃)alkenyl; an aryl (C₁₋₅)alkenyl; and a heteroaryl (C₁₋₅) alkenyl, each unsubstituted or substituted through available valencies. In yet another variation, R₁ is selected from the group consisting of a (C₂₋₁₀)alkynyl; an amino, alkyl, or alkoxy carbonyl (C₁₋₃)alkynyl; an amino, alkyl, or alkoxy thiocarbonyl (C₁₋₃)alkynyl; an amino, alkyl, or alkoxy sulfonyl (C₁₋₃)alkynyl; an amino, alkyl, or alkoxy sulfinyl (C₁₋₃)alkynyl; an amino, alkyl, or alkoxy imino (C₁₋₃)alkynyl; an aryl (C₁₋₅) alkynyl; and heteroaryl (C₁₋₅)alkynyl, each unsubstituted or substituted through available valencies.

[0186] In another variation, R₁ is substituted or unsubstituted (C₃₋₇)cycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted phenyl.

[0187] In another variation of the invention, R_1 is hydroxy. In yet another variation, R_1 is $-OR_{11}$, where R_{11} is selected from the group consisting of substituted or unsubstituted alkyl, cycloalkyl, aryl, heteroaryl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl.

[0188] In another variation, R_1 is a carbonyl group. In yet another variation, R_1 is selected from the group consisting of an aldehyde, acid, amide, and ester.

[0189] In yet another variation, R_1 is selected from the group consisting of pyrrolidin-1-ylcarbonyl, piperidin-1-ylcarbonyl, and morpholin-4-ylcarbonyl, each unsubstituted or substituted through available valencies.

[0190] In another variation of the invention, R_1 is $-Z-R_m$, where

Z is a moiety having a chain of 1-6 atoms selected from the group consisting of substituted or unsubstituted C, N, O, and S, attaching $-R_m$ to the ring, or Z is a unsubstituted or substituted $-(C_{1-3})$ alkylene optionally interrupted by O, N(O), $-NH$, SO, SO_2 , or carbonyl; and

$-R_m$ is selected from the group consisting of a substituted or unsubstituted (C_{1-7}) alkyl, $-(C_{2-7})$ alkene, $-(C_{2-7})$ alkyne, $-(C_{3-7})$ cycloalkyl, and aryl.

[0191] In another variation of each of the above embodiments and variations comprising R_1 , R_1 is $-ZR_m$, where

Z is a moiety providing 1-6 atom separation between R_m and the ring to which R_1 is attached, and

R_m is selected from the group consisting of a substituted or unsubstituted (C_{3-7}) cycloalkyl and aryl.

[0192] In one variation, the 1-6 atoms of Z comprise of carbon atoms. In another variation, the 1-6 atoms of Z are selected from the group consisting of at least one oxygen, or at least one nitrogen atom. In yet another variation, Z comprises of 1 atom.

[0193] In another variation, Z is selected from the group consisting of $-CH_2-$, $-CH_2CH_2-$, $-CH_2CH_2CH_2-$, $-C(O)-$, $-CH_2C(O)-$, $-C(O)CH_2-$, $-CH_2-C(O)CH_2-$, $-C(O)CH_2CH_2-$, $-CH_2CH_2C(O)-$, $-O-$, $-OCH_2-$, $-CH_2O-$, $-CH_2OCH_2-$, $-OCH_2CH_2-$, $-CH_2CH_2O-$, $-N(CH_3)-$, $-NHCH_2-$, $-CH_2NH-$, $-CH_2NHCH_2-$, $-NHCH_2CH_2-$, $-CH_2CH_2NH-$, $-NH-C(O)-$, $-NCH_3-C(O)-$, $-C(O)NH-$, $-C(O)NCH_3-$, $-NHC(O)CH_2-$, $-C(O)NHCH_2-$, $-C(O)CH_2NH-$, $-CH_2NHC(O)-$, $-CH_2C(O)NH-$, $-NHCH_2C(O)-$, $-S-$, $-SCH_2-$, $-CH_2S-$, $-SCH_2CH_2-$, $-CH_2SCH_2-$, $-CH_2CH_2S-$, $-C(O)S-$, $-C(O)SCH_2-$, $-CH_2C(O)S-$, $-C(O)CH_2S-$, and $-CH_2SC(O)-$, each substituted or unsubstituted.

[0194] In yet another variation, Z is selected from the group consisting of $-\text{CH}_2-$, $-\text{C}(\text{O})-$, $-\text{CH}_2\text{C}(\text{O})-$, $-\text{C}(\text{O})\text{CH}_2-$, $-\text{CH}_2-\text{C}(\text{O})\text{CH}_2-$, $-\text{C}(\text{O})\text{CH}_2\text{CH}_2-$, and $-\text{CH}_2\text{CH}_2\text{C}(\text{O})-$, each substituted or unsubstituted.

[0195] In one variation of each of the above embodiments and variations comprising Z, Z provides 1-3 atom separation between R_m and the ring.

[0196] In another variation of each of the above embodiments and variations comprising Z, Z provides 1 atom separation between R_m and the ring. In one variation, the 1 atom separation is provided by an atom selected from the group consisting of C, N, O, and S. In another variation, the 1 atom separation is provided by a carbon atom. In still another variation, the 1 atom separation is provided by an oxygen atom. In yet another variation, the 1 atom separation is provided by a nitrogen atom.

[0197] In a further variation of each of the above embodiments and variations comprising Z, Z is selected from the group consisting of $-\text{CH}_2-$, $-\text{CHR}_9-$, $-\text{C}(\text{R}_9)(\text{R}_9)-$, $-\text{C}(\text{O})-$, $-\text{C}(\text{S})-$, $-\text{C}(\text{NH})-$, $-\text{C}(\text{NR}_9)-$, $-\text{O}-$, $-\text{N}(\text{H})-$, $-\text{N}(\text{R}_9)-$, and $-\text{S}-$.

[0198] In yet another variation of each of the above embodiments and variations comprising Z, Z is a carbonyl.

[0199] In another variation according to the present invention, R_m is a substituted or unsubstituted (C_{3-7}) cycloalkyl. In yet another variation, R_m is a substituted or unsubstituted aryl. In yet another variation, R_m is a substituted or unsubstituted phenyl.

[0200] In another variation, R_m is a ring having a non-hydrogen substituent at a 2 or 3 position of the ring. In another variation according to the present invention, R_m has a non-hydrogen substituent at a 2 or 3 position of the ring selected from the group consisting of (C_{1-10}) alkyl, (C_{3-12}) cycloalkyl, hetero (C_{3-12}) cycloalkyl, aryl (C_{1-10}) alkyl, heteroaryl (C_{1-5}) alkyl, (C_{9-12}) bicycloaryl, hetero (C_{4-12}) bicycloaryl, carbonyl (C_{1-3}) alkyl, thiocarbonyl (C_{1-3}) alkyl, sulfonyl (C_{1-3}) alkyl, sulfinyl (C_{1-3}) alkyl, imino (C_{1-3}) alkyl, amino, aryl, heteroaryl, hydroxy, alkoxy, aryloxy, heteroaryloxy, carbonyl group, cyano, nitro, halo, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted.

[0201] In another variation, R_m is selected from the group consisting of alkyl, cycloalkyl, aryl, arylalkyl, heteroarylalkyl, and bicycloaryl, each substituted or unsubstituted.

[0202] In another variation of each of the above embodiments and variations comprising R_m , R_m is selected from the group consisting of (2-cyano)phenyl, (3-cyano)phenyl, (2-hydroxy)phenyl, (3-hydroxy)phenyl, (2-alkenyl)phenyl, (3-alkenyl)phenyl, (2-alkynyl)phenyl, (3-alkynyl)phenyl, (2-nitro)phenyl, (3-nitro)phenyl, (2-carboxy)phenyl, (3-carboxy)phenyl, (2-carboxamido)phenyl, (3-carboxamido)phenyl, (2-sulfonamido)phenyl, (3-sulfonamido)phenyl, (2-tetrazolyl)phenyl, (3-tetrazolyl)phenyl, (2-aminomethyl)phenyl, (3-aminomethyl)phenyl, (2-amino)phenyl, (3-amino)phenyl, (2-hydroxymethyl)phenyl, (3-hydroxymethyl)phenyl, (2-phenyl)phenyl, (3-phenyl)phenyl, (2-CONH₂)phenyl, (3-CONH₂)phenyl, (2-CONH(C₁₋₇)alkyl)phenyl, (3-CONH(C₁₋₇)alkyl)phenyl, (2-CO₂(C₁₋₇)alkyl)phenyl, (3-CO₂(C₁₋₇)alkyl)phenyl, -NH₂, -OH, -(C₃₋₇)alkyl, -alkene, -alkyne, -CCH, -(C₃₋₇)cycloalkyl, and -aryl, each substituted or unsubstituted.

[0203] In another variation, R_1 is $-(CR_5R_6)_{0-2}-(R_7)_{0-2}-R_8$, where

R_5 and R_6 are each independently hydrogen, halo or substituted or unsubstituted (C₁₋₈)alkyl or R_5 and R_6 are taken together to form a (C₃₋₆)cycloalkyl ring;

R_7 is selected from the group consisting of CO; CS; (C₁₋₁₀)alkylene, (C₃₋₁₂)cycloalkylene, hetero(C₃₋₁₂)cycloalkylene, amino, arylene, heteroarylene, imine, sulfonyl, and sulfinyl, each substituted or unsubstituted; and

R_8 is hydrogen or is selected from the group consisting of (C₁₋₇)alkyl, (C₂₋₇)alkenyl, (C₂₋₇)alkynyl, (C₃₋₇)cycloalkyl, (C₃₋₇)heterocycloalkyl, aryl, aryl(C₁₋₃)alkyl, heteroaryl(C₁₋₂)alkyl, heteroaryl, -SH, (C₁₋₇)alkyl-S-, (C₁₋₇)alkyl-SO-, (C₁₋₇)alkyl-SO₂-, CO, CS, NHCONNH₂, -NHCSNH₂, -NHCONH₂, -NHCO(C₁₋₇)alkyl, -NHCO₂(C₁₋₇)alkyl, -OCO-(C₁₋₅)alkyl, cyano, nitro, halo, hydroxy, perhalo(C₁₋₇)alkyl, perhalo(C₁₋₇)alkyloxy, -SO₂NH₂, (C₁₋₁₀)alkyloxy, (C₂₋₁₀)alkenyloxy, (C₂₋₁₀)alkynyloxy, aryloxy, or heteroaryloxy, each substituted or unsubstituted.

[0204] In another particular variation, R_1 is selected from the group consisting of -(CH₂)-(2-cyano)phenyl, -(CH₂)-(3-cyano)phenyl, -(CH₂)-(2-hydroxy)phenyl, -(CH₂)-(3-hydroxy)phenyl, -(CH₂)-(2-alkenyl)phenyl, -(CH₂)-(3-alkenyl)phenyl, -(CH₂)-(2-alkynyl)phenyl, -(CH₂)-(3-alkynyl)phenyl, -(CH₂)-(2-nitro)phenyl, -(CH₂)-(3-nitro)phenyl, -(CH₂)-(2-carboxy)phenyl, -(CH₂)-(3-carboxy)phenyl, -(CH₂)-(2-carboxamido)phenyl, -(CH₂)-(3-carboxamido)phenyl, -(CH₂)-(2-sulfonamido)phenyl, -(CH₂)-(3-sulfonamido)phenyl, -(CH₂)-(2-tetrazolyl)phenyl, -(CH₂)-(3-tetrazolyl)phenyl, -(CH₂)-(2-aminomethyl)phenyl, -(CH₂)-(3-aminomethyl)phenyl, -(CH₂)-(2-amino)phenyl, -(CH₂)-(3-amino)phenyl, -(CH₂)-(2-hydroxymethyl)phenyl,

-(CH₂)-(3-hydroxymethyl)phenyl, -(CH₂)-(2-phenyl)phenyl, -(CH₂)-(3-phenyl)phenyl, -(CH₂)-(2-CONH₂)phenyl, -(CH₂)-(3-CONH₂)phenyl, -(CH₂)-(2-CONH(C₁₋₇)alkyl)phenyl, -(CH₂)-(3-CONH(C₁₋₇)alkyl)phenyl, -(CH₂)-(2-CO₂(C₁₋₇)alkyl)phenyl, -(CH₂)-(3-CO₂(C₁₋₇)alkyl)phenyl, -CH₂-NH₂, -CH₂-OH, -CH₂-(C₃₋₇)alkyl, -CH₂-alkene, -CH₂-alkyne, -CH₂-CCH, -CH₂-(C₃₋₇)cycloalkyl, and -CH₂-aryl, each substituted or unsubstituted.

[0205] In another variation of each of the above embodiments and variations comprising R₁, R₁ is selected from the group consisting of -(C₁)alkyl-aryl, -(C₁)alkyl-bicycloaryl, -aminoaryl, -aminoheteroaryl, -aminobicycloaryl, -aminoheterobicycloaryl, -O-aryl, -O-heteroaryl, -O-bicycloaryl, -O-heterobicycloaryl, -(S)-aryl, -(S)-heteroaryl, -(S)-bicycloaryl, -S-heterobicycloaryl, -C(O)-aryl, -C(O)-heteroaryl, -C(O)-bicycloaryl, -C(O)-heterobicycloaryl, -C(S)-aryl, -C(S)-heteroaryl, -C(S)-bicycloaryl, -C(S)-heterobicycloaryl, -S(O)-aryl, -S(O)-heteroaryl, -S(O)-bicycloaryl, -SO₂-heterobicycloaryl, -SO₂-aryl, -SO₂-heteroaryl, -SO₂-bicycloaryl, -SO₂-heterobicycloaryl, -C(NR₉)-aryl, -C(NR₉)-heteroaryl, -C(NR₉)-bicycloaryl, -C(NR₉)-heterobicycloaryl, each substituted or unsubstituted.

[0206] In still another variation of each of the above embodiments and variations comprising R₁, R₁ is a substituted or unsubstituted aryl. In a further variation of each of the above embodiments and variations comprising R₁, R₁ is a substituted or unsubstituted phenyl. In yet another variation of each of the above embodiments and variations comprising R₁, R₁ is a substituted or unsubstituted heteroaryl.

Substituent R₂

[0207] In one variation of the invention, R₂ is selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, amino, cyano, thio, (C₁₋₁₀)alkyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, carbonyl (C₁₋₃)alkyl, thiocarbonyl (C₁₋₃)alkyl, sulfonyl (C₁₋₃)alkyl, sulfinyl (C₁₋₃)alkyl, imino (C₁₋₃)alkyl, hydroxy, alkoxy, aryloxy, heteroaryloxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, and a substituted or unsubstituted 4, 5, 6 or 7 membered ring.

[0208] In another variation, R₂ is selected from the group consisting of (C₃₋₁₂)cycloalkyl(C₁₋₅)alkyl, hetero(C₃₋₁₂)cycloalkyl(C₁₋₅)alkyl, aryl(C₁₋₁₀)alkyl, heteroaryl(C₁₋₅)alkyl, and (C₉₋₁₂)bicycloaryl(C₁₋₅)alkyl, each substituted or unsubstituted.

[0209] In yet another variation, R_2 is selected from the group consisting of I, Br, Cl, and F. In another particular variation, R_2 is selected from the group consisting of -SH, -SCH₃, and -S(C₁₋₃)alkyl unsubstituted or substituted through available valencies.

[0210] In another variation of the invention, R_2 is selected from the group consisting of -NH₂, -NHCH₃, -N(CH₃)₂, -NH(C₁₋₃)alkyl, -N(C₁₋₃alkyl)₂, -NR₁₄R₁₅, where R₁₄ is selected from the group consisting of a substituted or unsubstituted (C₃₋₁₂)cycloalkyl, hetero(C₃₋₁₂)cycloalkyl, (C₆₋₁₂)aryl, hetero(C₅₋₁₂)aryl, (C₉₋₁₂)bicycloaryl and hetero(C₄₋₁₂)bicycloaryl, and R₁₅ is selected from the group consisting of hydrogen and a substituted or unsubstituted (C₁₋₈)alkyl, and -NR₁₀R₁₁, where R₁₀ and -R₁₁ together are -(CH₂)₄₋₅- optionally interrupted by one O, S, NH or -N(C₁₋₃)alkyl group; each unsubstituted or substituted through available valencies.

[0211] In another variation according to the present invention, R_2 is selected from the group consisting of a (C₁₋₃)alkyl; an amino, alkyl, or alkoxy carbonyl (C₁₋₃)alkyl; an amino, alkyl, or alkoxy thiocarbonyl (C₁₋₃)alkyl; an amino, alkyl, or alkoxy sulfonyl (C₁₋₃)alkyl; an amino, alkyl, or alkoxy sulfinyl (C₁₋₃)alkyl; an amino, alkyl, or alkoxy imino (C₁₋₃)alkyl; an aryl (C₁₋₅)alkyl; and a heteroaryl (C₁₋₅)alkyl, each unsubstituted or substituted through available valencies.

[0212] In another variation according to the present invention, R_2 is selected from the group consisting of a (C₂₋₁₀)alkenyl; an amino, alkyl, or alkoxy carbonyl (C₁₋₃)alkenyl; an amino, alkyl, or alkoxy thiocarbonyl (C₁₋₃)alkenyl; an amino, alkyl, or alkoxy sulfonyl (C₁₋₃)alkenyl; an amino, alkyl, or alkoxy sulfinyl (C₁₋₃)alkenyl; an amino, alkyl, or alkoxy imino (C₁₋₃)alkenyl; an aryl (C₁₋₅)alkenyl, and a heteroaryl (C₁₋₅)alkenyl, each unsubstituted or substituted through available valencies.

[0213] In yet another variation according to the present invention, R_2 is selected from the group consisting of a (C₂₋₁₀)alkynyl; an amino, alkyl, or alkoxy carbonyl (C₁₋₃)alkynyl; an amino, alkyl, or alkoxy thiocarbonyl (C₁₋₃)alkynyl; an amino, alkyl, or alkoxy sulfonyl (C₁₋₃)alkynyl; an amino, alkyl, or alkoxy sulfinyl (C₁₋₃)alkynyl; an amino, alkyl, or alkoxy imino (C₁₋₃)alkynyl; an aryl (C₁₋₅)alkynyl; and a heteroaryl (C₁₋₅)alkynyl, each unsubstituted or substituted through available valencies.

[0214] In one variation of each of the above embodiments and variations comprising R_2 , R_2 is a substituted or unsubstituted 3, 4, 5, 6, or 7 membered ring.

[0215] In another variation, R_2 is substituted or unsubstituted (C₃₋₇)cycloalkyl (*i.e.*, a substituted or unsubstituted 3, 4, 5, 6, or 7 membered cycloalkyl). In another variation, R_2 is substituted or unsubstituted (C₃₋₇)heterocycloalkyl (*e.g.*, a substituted or unsubstituted 4, 5, 6, or 7 membered

heterocycloalkyl). In another variation, R_2 is substituted or unsubstituted aryl. In another variation, R_2 is substituted or unsubstituted phenyl. In yet another variation, R_2 is substituted or unsubstituted heteroaryl.

[0216] In another variation, R_2 is hydroxy.

[0217] In yet another variation according to the present invention, R_2 is $-OR_{11}$, where R_{11} is selected from the group consisting of substituted or unsubstituted alkyl, cycloalkyl, aryl, heteroaryl, heterocycloalkyl, arylalkyl, heteroarylalkyl, bicycloaryl, and heterobicycloaryl.

[0218] In yet another variation, R_2 is a carbonyl group. In another variation according to the present invention, R_2 is selected from the group consisting of an aldehyde, acid, amide, ketone and ester.

[0219] In another variation according to the present invention, R_2 is selected from the group consisting of pyrrolidin-1-ylcarbonyl, piperidin-1-ylcarbonyl, and morpholin-4-ylcarbonyl, each unsubstituted or substituted through available valencies.

[0220] In another variation according to the present invention, R_2 is selected from the group consisting of 3-amino-piperidin-1-yl, 3-aminomethyl-pyrrolidin-1-yl, azetidin-1-yl, 3-aminoazetidin-1-yl, pyrrolidin-1-yl, 3-aminocyclopent-1-yl, 3-aminomethylcyclopent-1-yl, 3-aminomethylcyclohex-1-yl, hexahydroazepin-1-yl, 3-aminohexahydroazepin-1-yl, 3-amino-cyclohex-1-yl, piperazin-1-yl, homopiperazin-1-yl, 3-amino-pyrrolidin-1-yl, and R-3-aminopiperidin-1-yl, each substituted or unsubstituted.

[0221] In another variation of the present invention, R_2 is MR_aR_b , where

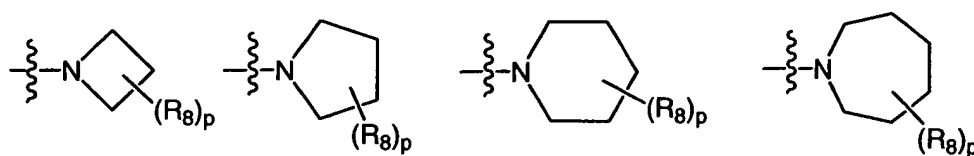
M is CH or N, R_a is H or (C_{1-6}) alkyl, and R_b is amino (C_{0-4}) alkyl; or

M together with R_a and R_b form a ring of 4-7 atoms selected from the group consisting of C, N, O, and S each is independently substituted or unsubstituted and where C, N and S are optionally oxidized.

[0222] In another variation, R_2 comprises a primary or secondary amine where the nitrogen of the amine is 1-6 atoms from the nearest ring atom. In another particular variation, R_2 comprises a primary or secondary amine where the nitrogen of the amine is 2-5 atoms from the nearest ring atom. In yet another variation, R_2 comprises a primary or secondary amine where the nitrogen of the amine is 3-4 atoms from the nearest ring atom.

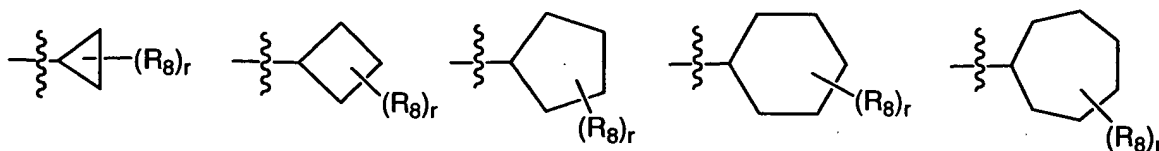
[0223] In a further variation of each of the above embodiments and variations comprising R_2 , R_2 is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring wherein at least one substituent is selected from the group consisting of a primary, secondary or tertiary amine, a heterocycloalkyl comprising a nitrogen ring atom, and a heteroaryl comprising a nitrogen ring atom.

[0224] In a further variation of each of the above embodiments and variations comprising R_2 , R_2 is selected from the group consisting of



wherein p is 0-12 and each R_8 is independently selected from the group consisting of halo, perhalo(C_{1-10})alkyl, CF_3 , cyano, nitro, hydroxy, alkyl, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted.

[0225] In yet another variation of each of the above embodiments and variations comprising R_2 , R_2 is selected from the group consisting of



wherein r is 0-13 and each R_8 is independently selected from the group consisting of halo, perhalo(C_{1-10})alkyl, CF_3 , cyano, nitro, hydroxy, alkyl, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted.

[0226] In another variation of each of the above embodiments and variations comprising R₂, R₂ is a substituted or unsubstituted heteroaryl selected from the group consisting of furan, thiophene, pyrrole, pyrazole, triazole, isoxazole, oxazole, thiazole, isothiazole, oxadiazole, pyridine, pyridazine, pyrimidine, pyrazine, triazine, benzofuran, isobenzofuran, benzothiophene, isobenzothiophene, imidazole, benzimidazole, indole, isoindole, quinoline, isoquinoline, cinnoline, quinazoline, naphthyridine, pyridopyridine, quinoxaline, phthalazine, and benzothiazole, each substituted or unsubstituted.

[0227] In still another variation of each of the above embodiments and variations comprising R₂, R₂ is selected from the group consisting of (C₃₋₁₂)cycloalkyl, hetero(C₃₋₁₂)cycloalkyl, aryl(C₁₋₁₀)alkyl, heteroaryl (C₁₋₅)alkyl, (C₉₋₁₂)bicycloaryl, and hetero(C₄₋₁₂)bicycloaryl, each substituted or unsubstituted.

[0228] In a further variation of each of the above embodiments and variations comprising R₂, R₂ is a substituted or unsubstituted (C₃₋₇)cycloalkyl ring, optionally comprising O, N(O), N, S, SO, SO₂ or a carbonyl group in the ring.

Substituent R₁₉

[0229] In one variation of each of the above embodiments and variations comprising R₁₉, two R₁₉ are taken together to form a substituted or unsubstituted ring.

[0230] In another variation of each of the above embodiments and variations comprising R₁₉, two R₁₉ are taken together to form a substituted or unsubstituted fused or bridged ring.

[0231] In still another variation of each of the above embodiments and variations comprising R₁₉, two R₁₉ are taken together to form a substituted or unsubstituted bridged or spiro ring.

Substituents U and V

[0232] In one variation of each of the above embodiments and variations comprising U, U provides 1-4 atom separation between V and the ring. In another variation, U provides 1-3 atom separation between V and the ring.

[0233] In still another variation, U is selected from the group consisting of -CH₂-, -CH₂CH₂-, -CH₂CH₂CH₂-, -C(O)-, -CH₂C(O)-, -C(O)CH₂-, -CH₂-C(O)CH₂-, -C(O)CH₂CH₂-, -CH₂CH₂C(O)-, -O-, -OCH₂-, -CH₂O-, -CH₂OCH₂-, -OCH₂CH₂-, -CH₂CH₂O-, -N(CH₃)-, -NHCH₂-, -CH₂NH-,

-CH₂NHCH₂-, -NHCH₂CH₂-, -CH₂CH₂NH-, -NH-C(O)-, -NCH₃-C(O)-, -C(O)NH-, -C(O)NCH₃-, -NHC(O)CH₂-, -C(O)NHCH₂-, -C(O)CH₂NH-, -CH₂NHC(O)-, -CH₂C(O)NH-, -NHCH₂C(O)-, -S-, -SCH₂-, -CH₂S-, -SCH₂CH₂-, -CH₂SCH₂-, -CH₂CH₂S-, -C(O)S-, -C(O)SCH₂-, -CH₂C(O)S-, -C(O)CH₂S-, and -CH₂SC(O)-, each substituted or unsubstituted.

[0234] In a further variation of each of the above embodiments and variations comprising U, U is selected from the group consisting of -CH₂-, -CHR₉-, -C(R₉)(R₉)-, -O-, -N(H)-, -N(R₉)-, and -S-.

[0235] In one variation of each of the above embodiments and variations comprising V, V is selected from the group consisting of a primary, secondary or tertiary amine, a heterocycloalkyl comprising a nitrogen ring atom, and a heteroaryl comprising a nitrogen ring atom

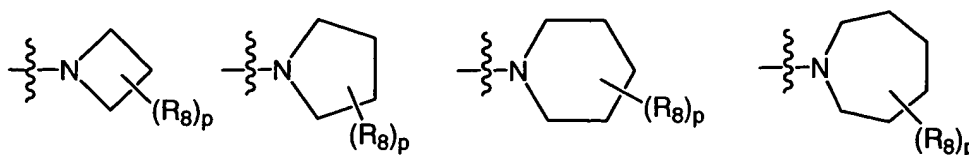
[0236] In another variation of each of the above embodiments and variations comprising V, V is selected from the group consisting of a substituted or unsubstituted 3, 4, 5, 6 or 7 membered ring wherein at least one substituent is selected from the group consisting of a primary, secondary or tertiary amine, a heterocycloalkyl comprising a nitrogen ring atom, and a heteroaryl comprising a nitrogen ring atom.

[0237] In still another variation of each of the above embodiments and variations comprising V, the basic nitrogen of V is separated from the ring atom to which R₂ is attached by between 1-5 atoms.

[0238] In a further variation of each of the above embodiments and variations comprising V, the basic nitrogen of V forms part of a primary, secondary or tertiary amine.

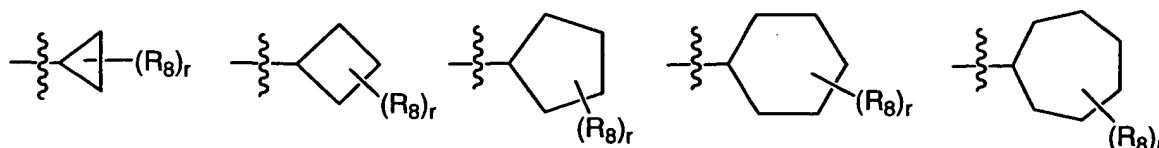
[0239] In yet another variation of each of the above embodiments and variations comprising V, the basic nitrogen of V is a nitrogen ring atom of a heterocycloalkyl comprising a nitrogen ring atom or a heteroaryl comprising a nitrogen ring atom.

[0240] In one variation of each of the above embodiments and variations comprising -UV, -UV is selected from the group consisting of



wherein p is 0-12 and each R_8 is independently selected from the group consisting of halo, perhalo(C_{1-10})alkyl, CF_3 , cyano, nitro, hydroxy, alkyl, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, with the proviso that at least one R_8 serves as V.

[0241] In another variation of each of the above embodiments and variations comprising -UV, -UV is selected from the group consisting of



wherein r is 0-13 and each R_8 is independently selected from the group consisting of halo, perhalo(C_{1-10})alkyl, CF_3 , cyano, nitro, hydroxy, alkyl, aryl, heteroaryl, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, arylalkyl, heteroarylalkyl, cycloalkyl, heterocycloalkyl, amino, thio, alkoxy, carbonyl group, imino group, sulfonyl group and sulfinyl group, each substituted or unsubstituted, with the proviso that at least one R_8 serves as V.

[0242] In one variation of each of the above embodiments and variations comprising R_8 , at least one R_8 is a primary, secondary or tertiary amine.

[0243] In another variation of each of the above embodiments and variations comprising R_8 , at least one R_8 is a substituted or unsubstituted heterocycloalkyl comprising a nitrogen ring atom or a substituted or unsubstituted heteroaryl comprising a nitrogen ring atom.

[0244] In still another variation of each of the above embodiments and variations comprising R_8 , at least one R_8 is selected from the group consisting of $-NH_2$, $-NH(C_{1-5} \text{ alkyl})$, $-N(C_{1-5} \text{ alkyl})_2$, piperazine, imidazole, and pyridine.

[0245] In another variation according to the present invention,

R_1 is selected from the group consisting of $-(CH_2)-(2\text{-cyano})\text{phenyl}$, $-(CH_2)-(3\text{-cyano})\text{phenyl}$, $-(CH_2)-(2\text{-hydroxy})\text{phenyl}$, $-(CH_2)-(3\text{-hydroxy})\text{phenyl}$, $-(CH_2)-(2\text{-alkenyl})\text{phenyl}$, $-(CH_2)-(3\text{-$

alkenyl)phenyl, $-(CH_2)-(2-alkynyl)phenyl$, $-(CH_2)-(3-alkynyl)phenyl$, $-(CH_2)-(2-nitro)phenyl$, $-(CH_2)-(3-nitro)phenyl$, $-(CH_2)-(2-carboxy)phenyl$, $-(CH_2)-(3-carboxy)phenyl$, $-(CH_2)-(2-carboxamido)phenyl$, $-(CH_2)-(3-carboxamido)phenyl$, $-(CH_2)-(2-sulfonamido)phenyl$, $-(CH_2)-(3-sulfonamido)phenyl$, $-(CH_2)-(2-tetrazolyl)phenyl$, $-(CH_2)-(3-tetrazolyl)phenyl$, $-(CH_2)-(2-aminomethyl)phenyl$, $-(CH_2)-(3-aminomethyl)phenyl$, $-(CH_2)-(2-amino)phenyl$, $-(CH_2)-(3-amino)phenyl$, $-(CH_2)-(2-hydroxymethyl)phenyl$, $-(CH_2)-(3-hydroxymethyl)phenyl$, $-(CH_2)-(2-phenyl)phenyl$, $-(CH_2)-(3-phenyl)phenyl$, $-(CH_2)-(2-halo)phenyl$, $-(CH_2)-(3-halo)phenyl$, $-(CH_2)-(2-CONH_2)phenyl$, $-(CH_2)-(3-CONH_2)phenyl$, $-(CH_2)-(2-CONH(C_{1-7})alkyl)phenyl$, $-(CH_2)-(3-CONH(C_{1-7})alkyl)phenyl$, $-(CH_2)-(2-CO_2(C_{1-7})alkyl)phenyl$, $-(CH_2)-(3-CO_2(C_{1-7})alkyl)phenyl$, $-CH_2-NH_2$, $-CH_2-OH$, $-CH_2-(C_{3-7})alkyl$, $-CH_2-alkene$, $-CH_2-alkyne$, $-CH_2-CCH$, $-CH_2-(C_{3-7})cycloalkyl$, and $-CH_2-aryl$, each substituted or unsubstituted, and

R_2 is selected from the group consisting of 3-amino-piperidin-1-yl, 3-aminomethylpyrrolidin-1-yl, azetidin-1-yl, 3-aminoazetidin-1-yl, pyrrolidin-1-yl, 3-aminocyclopent-1-yl, 3-aminomethylcyclopent-1-yl, 3-aminomethylcyclohex-1-yl, hexahydroazepin-1-yl, 3-aminohexahydroazepin-1-yl, 3-amino-cyclohex-1-yl, piperazin-1-yl, homopiperazin-1-yl, 3-aminopyrrolidin-1-yl, and R-3-aminopiperidin-1-yl, each substituted or unsubstituted.

[0246] In another particular variation according to the present invention,

R_1 is selected from the group consisting of $-NH_2$, $-NHCH_3$, $-N(CH_3)_2$, $-NHC_{1-3}alkyl$, and $-N(C_{1-3}alkyl)_2$ each unsubstituted or substituted through available valencies, and

R_2 is selected from the group consisting of 3-amino-piperidin-1-yl, 3-aminomethylpyrrolidin-1-yl, azetidin-1-yl, 3-aminoazetidin-1-yl, pyrrolidin-1-yl, 3-aminocyclopent-1-yl, 3-aminomethylcyclopent-1-yl, 3-aminomethylcyclohex-1-yl, hexahydroazepin-1-yl, 3-aminohexahydroazepin-1-yl, 3-amino-cyclohex-1-yl, piperazin-1-yl, homopiperazin-1-yl, 3-aminopyrrolidin-1-yl, and R-3-aminopiperidin-1-yl, each substituted or unsubstituted.

[0247] In another variation according to the present invention,

Q is CO,

R_1 is selected from the group consisting of $-(CH_2)-(2-cyano)phenyl$, $-(CH_2)-(3-cyano)phenyl$, $-(CH_2)-(2-hydroxy)phenyl$, $-(CH_2)-(3-hydroxy)phenyl$, $-(CH_2)-(2-alkenyl)phenyl$, $-(CH_2)-(3-alkenyl)phenyl$, $-(CH_2)-(2-alkynyl)phenyl$, $-(CH_2)-(3-alkynyl)phenyl$, $-(CH_2)-(2-nitro)phenyl$,

-(CH₂)-(3-nitro)phenyl, -(CH₂)-(2-carboxy)phenyl, -(CH₂)-(3-carboxy)phenyl, -(CH₂)-(2-carboxamido)phenyl, -(CH₂)-(3-carboxamido)phenyl, -(CH₂)-(2-sulfonamido)phenyl, -(CH₂)-(3-sulfonamido)phenyl, -(CH₂)-(2-tetrazolyl)phenyl, -(CH₂)-(3-tetrazolyl)phenyl, -(CH₂)-(2-aminomethyl)phenyl, -(CH₂)-(3-aminomethyl)phenyl, -(CH₂)-(2-amino)phenyl, -(CH₂)-(3-amino)phenyl, -(CH₂)-(2-hydroxymethyl)phenyl, -(CH₂)-(3-hydroxymethyl)phenyl, -(CH₂)-(2-phenyl)phenyl, -(CH₂)-(3-phenyl)phenyl, -(CH₂)-(2-halo)phenyl, -(CH₂)-(3-halo)phenyl, -(CH₂)-(2-CONH₂)phenyl, -(CH₂)-(3-CONH₂)phenyl, -(CH₂)-(2-CONH(C₁₋₇)alkyl)phenyl, -(CH₂)-(3-CONH(C₁₋₇)alkyl)phenyl, -(CH₂)-(2-CO₂(C₁₋₇)alkyl)phenyl, -(CH₂)-(3-CO₂(C₁₋₇)alkyl)phenyl, -CH₂-NH₂, -CH₂-OH, -CH₂-(C₃₋₇)alkyl, -CH₂-alkene, -CH₂-alkyne, -CH₂-CCH, -CH₂-(C₃₋₇)cycloalkyl, and -CH₂-aryl, each substituted or unsubstituted, and

R₂ is selected from the group consisting of 3-amino-piperidin-1-yl, 3-aminomethyl-pyrrolidin-1-yl, azetidin-1-yl, 3-aminoazetidin-1-yl, pyrrolidin-1-yl, 3-aminocyclopent-1-yl, 3-aminomethylcyclopent-1-yl, 3-aminomethylcyclohex-1-yl, hexahydroazepin-1-yl, 3-aminohexahydroazepin-1-yl, 3-amino-cyclohex-1-yl, piperazin-1-yl, homopiperazin-1-yl, 3-amino-pyrrolidin-1-yl, and R-3-aminopiperidin-1-yl, each substituted or unsubstituted.

[0248] In another variation according to the present invention,

Q is SO,

R₁ is selected from the group consisting of -(CH₂)-(2-cyano)phenyl, -(CH₂)-(3-cyano)phenyl, -(CH₂)-(2-hydroxy)phenyl, -(CH₂)-(3-hydroxy)phenyl, -(CH₂)-(2-alkenyl)phenyl, -(CH₂)-(3-alkenyl)phenyl, -(CH₂)-(2-alkynyl)phenyl, -(CH₂)-(3-alkynyl)phenyl, -(CH₂)-(2-nitro)phenyl, -(CH₂)-(3-nitro)phenyl, -(CH₂)-(2-carboxy)phenyl, -(CH₂)-(3-carboxy)phenyl, -(CH₂)-(2-carboxamido)phenyl, -(CH₂)-(3-carboxamido)phenyl, -(CH₂)-(2-sulfonamido)phenyl, -(CH₂)-(3-sulfonamido)phenyl, -(CH₂)-(2-tetrazolyl)phenyl, -(CH₂)-(3-tetrazolyl)phenyl, -(CH₂)-(2-aminomethyl)phenyl, -(CH₂)-(3-aminomethyl)phenyl, -(CH₂)-(2-amino)phenyl, -(CH₂)-(3-amino)phenyl, -(CH₂)-(2-hydroxymethyl)phenyl, -(CH₂)-(3-hydroxymethyl)phenyl, -(CH₂)-(2-phenyl)phenyl, -(CH₂)-(3-phenyl)phenyl, -(CH₂)-(2-halo)phenyl, -(CH₂)-(3-halo)phenyl, -(CH₂)-(2-CONH₂)phenyl, -(CH₂)-(3-CONH₂)phenyl, -(CH₂)-(2-CONH(C₁₋₇)alkyl)phenyl, -(CH₂)-(3-CONH(C₁₋₇)alkyl)phenyl, -(CH₂)-(2-CO₂(C₁₋₇)alkyl)phenyl, -(CH₂)-(3-CO₂(C₁₋₇)alkyl)phenyl, -CH₂-NH₂, -CH₂-OH, -CH₂-(C₃₋₇)alkyl, -CH₂-alkene,

-CH₂-alkyne, -CH₂-CCH, -CH₂-(C₃₋₇)cycloalkyl, and -CH₂-aryl, each substituted or unsubstituted, and

R₂ is selected from the group consisting of 3-amino-piperidin-1-yl, 3-aminomethyl-pyrrolidin-1-yl, azetidin-1-yl, 3-aminoazetidin-1-yl, pyrrolidin-1-yl, 3-aminocyclopent-1-yl, 3-aminomethylcyclopent-1-yl, 3-aminomethylcyclohex-1-yl, hexahydroazepin-1-yl, 3-aminohexahydroazepin-1-yl, 3-amino-cyclohex-1-yl, piperazin-1-yl, homopiperazin-1-yl, 3-amino-pyrrolidin-1-yl, and R-3-aminopiperidin-1-yl, each substituted or unsubstituted.

[0249] In yet another variation according to the present invention,

Q is SO₂,

R₁ is selected from the group consisting of -(CH₂)-(2-cyano)phenyl, -(CH₂)-(3-cyano)phenyl, -(CH₂)-(2-hydroxy)phenyl, -(CH₂)-(3-hydroxy)phenyl, -(CH₂)-(2-alkenyl)phenyl, -(CH₂)-(3-alkenyl)phenyl, -(CH₂)-(2-alkynyl)phenyl, -(CH₂)-(3-alkynyl)phenyl, -(CH₂)-(2-nitro)phenyl, -(CH₂)-(3-nitro)phenyl, -(CH₂)-(2-carboxy)phenyl, -(CH₂)-(3-carboxy)phenyl, -(CH₂)-(2-carboxamido)phenyl, -(CH₂)-(3-carboxamido)phenyl, -(CH₂)-(2-sulfonamido)phenyl, -(CH₂)-(3-sulfonamido)phenyl, -(CH₂)-(2-tetrazolyl)phenyl, -(CH₂)-(3-tetrazolyl)phenyl, -(CH₂)-(2-aminomethyl)phenyl, -(CH₂)-(3-aminomethyl)phenyl, -(CH₂)-(2-amino)phenyl, -(CH₂)-(3-amino)phenyl, -(CH₂)-(2-hydroxymethyl)phenyl, -(CH₂)-(3-hydroxymethyl)phenyl, -(CH₂)-(2-phenyl)phenyl, -(CH₂)-(3-phenyl)phenyl, -(CH₂)-(2-halo)phenyl, -(CH₂)-(3-halo)phenyl, -(CH₂)-(2-CONH₂)phenyl, -(CH₂)-(3-CONH₂)phenyl, -(CH₂)-(2-CONH(C₁₋₇)alkyl)phenyl, -(CH₂)-(3-CONH(C₁₋₇)alkyl)phenyl, -(CH₂)-(2-CO₂(C₁₋₇)alkyl)phenyl, -(CH₂)-(3-CO₂(C₁₋₇)alkyl)phenyl, -CH₂-NH₂, -CH₂-OH, -CH₂-(C₃₋₇)alkyl, -CH₂-alkene, -CH₂-alkyne, -CH₂-CCH, -CH₂-(C₃₋₇)cycloalkyl, and -CH₂-aryl, each substituted or unsubstituted, and

R₂ is selected from the group consisting of 3-amino-piperidin-1-yl, 3-aminomethyl-pyrrolidin-1-yl, azetidin-1-yl, 3-aminoazetidin-1-yl, pyrrolidin-1-yl, 3-aminocyclopent-1-yl, 3-aminomethylcyclopent-1-yl, 3-aminomethylcyclohex-1-yl, hexahydroazepin-1-yl, 3-aminohexahydroazepin-1-yl, 3-amino-cyclohex-1-yl, piperazin-1-yl, homopiperazin-1-yl, 3-amino-pyrrolidin-1-yl, and R-3-aminopiperidin-1-yl, each substituted or unsubstituted.

[0250] In yet another variation according to the present invention,

Q is CO,

R₁ is selected from the group consisting of -NH₂, -NHCH₃, -N(CH₃)₂, -NHC₁₋₃-alkyl, and -N(C₁₋₃-alkyl)₂ each unsubstituted or substituted through available valencies, and

R₂ is selected from the group consisting of 3-amino-piperidin-1-yl, 3-aminomethyl-pyrrolidin-1-yl, azetidin-1-yl, 3-aminoazetidin-1-yl, pyrrolidin-1-yl, 3-aminocyclopent-1-yl, 3-aminomethylcyclopent-1-yl, 3-aminomethylcyclohex-1-yl, hexahydroazepin-1-yl, 3-aminohexahydroazepin-1-yl, 3-amino-cyclohex-1-yl, piperazin-1-yl, homopiperazin-1-yl, 3-amino-pyrrolidin-1-yl, and R-3-aminopiperidin-1-yl, each substituted or unsubstituted.

[0251] In another variation according to the present invention,

Q is SO,

R₁ is selected from the group consisting of -NH₂, -NHCH₃, -N(CH₃)₂, -NHC₁₋₃-alkyl, and -N(C₁₋₃-alkyl)₂ each unsubstituted or substituted through available valencies, and

R₂ is selected from the group consisting of 3-amino-piperidin-1-yl, 3-aminomethyl-pyrrolidin-1-yl, azetidin-1-yl, 3-aminoazetidin-1-yl, pyrrolidin-1-yl, 3-aminocyclopent-1-yl, 3-aminomethylcyclopent-1-yl, 3-aminomethylcyclohex-1-yl, hexahydroazepin-1-yl, 3-aminohexahydroazepin-1-yl, 3-amino-cyclohex-1-yl, piperazin-1-yl, homopiperazin-1-yl, 3-amino-pyrrolidin-1-yl, and R-3-aminopiperidin-1-yl, each substituted or unsubstituted.

[0252] In another variation according to the present invention,

Q is SO₂,

R₁ is selected from the group consisting of -NH₂, -NHCH₃, -N(CH₃)₂, -NHC₁₋₃-alkyl, and -N(C₁₋₃-alkyl)₂ each unsubstituted or substituted through available valencies, and

R₂ is selected from the group consisting of 3-amino-piperidin-1-yl, 3-aminomethyl-pyrrolidin-1-yl, azetidin-1-yl, 3-aminoazetidin-1-yl, pyrrolidin-1-yl, 3-aminocyclopent-1-yl, 3-aminomethylcyclopent-1-yl, 3-aminomethylcyclohex-1-yl, hexahydroazepin-1-yl, 3-aminohexahydroazepin-1-yl, 3-amino-cyclohex-1-yl, piperazin-1-yl, homopiperazin-1-yl, 3-amino-pyrrolidin-1-yl, and R-3-aminopiperidin-1-yl, each substituted or unsubstituted.

[0253] Particular examples of DPP-IV inhibitors according to the present invention include:

2-[2-(3-Amino-piperidin-1-yl)-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile;

2,4-Dichloro-quinazoline;

2-Chloro-3H-quinazolin-4-one;

2-(2-Chloro-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile;

2-[2-(3-Amino-piperidin-1-yl)-6,7-dimethoxy-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile;

2-Chloro-6,7-dimethoxy-3H-quinazolin-4-one;

2-(2-Chloro-6,7-dimethoxy-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile;

2-[2-(3-Amino-piperidin-1-yl)-8-methoxy-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile;

8-Methoxy-1H-quinazoline-2,4-dione;

2,4-Dichloro-8-methoxy-quinazoline;

2-Chloro-8-methoxy-3H-quinazolin-4-one;

2-(2-Chloro-8-methoxy-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile;

2-[2-(3-Amino-piperidin-1-yl)-7-chloro-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile,

TFA salt;

2,7-Dichloro-3H-quinazolin-4-one;

2-(2,7-Dichloro-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile;

2-[2-(3-Amino-piperidin-1-yl)-8-chloro-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile,

TFA salt;

2,8-Dichloro-3H-quinazolin-4-one;

2-(2,8-Dichloro-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile;

6-Fluoro-1H-quinazoline-2,4-dione;

2,4-Dichloro-6-fluoro-quinazoline;

2-Chloro-6-fluoro-3H-quinazolin-4-one;

2-(2-Chloro-6-fluoro-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile;

(R) 2-[2-(3-Amino-piperidin-1-yl)-6-fluoro-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile

TFA salt;

2-[2-(3-Amino-piperidin-1-yl)-7-methyl-6-oxo-6,7-dihydro-purin-1-ylmethyl]-benzonitrile;

2-[2-(3-Amino-piperidin-1-yl)-9-methyl-6-oxo-6,9-dihydro-purin-1-ylmethyl]-benzonitrile;

2,6-Dichloro-7-methyl-7H-purine;

2,6-Dichloro-9-methyl-9H-purine;

2-Chloro-7-methyl-1,7-dihydro-purin-6-one;

2-Chloro-9-methyl-1,9-dihydro-purin-6-one;

2-(2-Chloro-7-methyl-6-oxo-6,7-dihydro-purin-1-ylmethyl)-benzonitrile;

2-(2-Chloro-9-methyl-6-oxo-6,9-dihydro-purin-1-ylmethyl)-benzonitrile;
2-{2-[(R)-3-Amino-piperidin-1-yl]-6-oxo-6,7-dihydro-purin-1-ylmethyl}-benzonitrile;
7-Benzyloxymethyl-2,6-dichloro-7H-purine;
9-Benzyloxymethyl-2,6-dichloro-9H-purine;
7-Benzyloxymethyl-2-chloro-1,7-dihydro-purin-6-one;
9-Benzyloxymethyl-2-chloro-1,9-dihydro-purin-6-one;
2-(7-Benzyloxymethyl-2-chloro-6-oxo-6,7-dihydro-purin-1-ylmethyl)-benzonitrile;
2-(9-Benzyloxymethyl-2-chloro-6-oxo-6,9-dihydro-purin-1-ylmethyl)-benzonitrile;
2-(2-Chloro-6-oxo-6,9-dihydro-purin-1-ylmethyl)-benzonitrile;
2-[2-(3-(R)-Amino-piperidin-1-yl)-6-chloro-4-oxo-4H-quinazolin-3-ylmethyl]-
benzonitrile, TFA salt;
2,6-Dichloro-3H-quinazolin-4-one;
2-(2,6-Dichloro-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile;
2-[2-(3-(R)-Amino-piperidin-1-yl)-7-fluoro-6-methoxy-4-oxo-4H-quinazolin-3-ylmethyl]-
benzonitrile, TFA salt;
7-Fluoro-6-methoxy-1H-quinazoline-2,4-dione;
2-Chloro-7-fluoro-6-methoxy-3H-quinazolin-4-one;
2-(2-Chloro-7-fluoro-6-methoxy-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile;
2-[2-(3-(R)-Amino-piperidin-1-yl)-6-methoxy-4-oxo-4H-pyrido[3,4-*d*]pyrimidin-3-
ylmethyl]-benzonitrile, TFA salt;
6-Methoxy-1H-pyrido[3,4-*d*]pyrimidine-2,4-dione;
2-Chloro-6-methoxy-3H-pyrido[3,4-*d*]pyrimidin-4-one;
2-(2-Chloro-6-methoxy-4-oxo-4H-pyrido[3,4-*d*]pyrimidin-3-ylmethyl)-benzonitrile;
2-[6-(3-(R)-Amino-piperidin-1-yl)-1-methyl-4-oxo-1,4-dihydro-pyrazolo[3,4-
d]pyrimidin-5-ylmethyl]-benzonitrile, TFA salt;
6-Chloro-1-methyl-1,5-dihydro-pyrazolo[3,4-*d*]pyrimidin-4-one;
2-(6-Chloro-1-methyl-4-oxo-1,4-dihydro-pyrazolo[3,4-*d*]pyrimidin-5-ylmethyl)-
benzonitrile;
2-[2-(3-(R)-Amino-piperidin-1-yl)-5-fluoro-4-oxo-4H-quinazolin-3-ylmethyl]-
benzonitrile, TFA salt;

2-Chloro-5-fluoro-3*H*-quinazolin-4-one;
2-(2-Chloro-5-fluoro-4-oxo-4*H*-quinazolin-3-ylmethyl)-benzonitrile;
2-[5-(3-(*R*)-Amino-piperidin-1-yl)-1-methyl-7-oxo-1,7-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidin-6-ylmethyl]-benzonitrile, TFA salt;
5-Chloro-1-methyl-1,6-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidin-7-one;
2-(5-Chloro-1-methyl-7-oxo-1,7-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidin-6-ylmethyl)-benzonitrile;
2-[5-(3-(*R*)-Amino-piperidin-1-yl)-2-methyl-7-oxo-2,7-dihydro[1,2,3]triazolo[4,5-*d*]pyrimidin-6-ylmethyl]-benzonitrile, TFA salt;
5-Chloro-2-methyl-2,6-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidin-7-one;
2-(5-Chloro-2-methyl-7-oxo-2,7-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidin-6-ylmethyl)-benzonitrile;
2-[2-(3-(*R*)-Amino-piperidin-1-yl)-4-oxo-5,6,7,8-tetrahydro-4*H*-quinazolin-3-ylmethyl]-benzonitrile, TFA salt;
2-Chloro-5,6,7,8-tetrahydro-3*H*-quinazolin-4-one;
2-(2-Chloro-4-oxo-5,6,7,8-tetrahydro-4*H*-quinazolin-3-ylmethyl)-benzonitrile;
2-[2-(3-(*R*)-Amino-piperidin-1-yl)-6-chloro-4-oxo-4*H*-pyrido[3,4-*d*]pyrimidin-3-ylmethyl]-benzonitrile, TFA salt;
1,7-Dihydro-pyrido[3,4-*d*]pyrimidine-2,4,6-trione;
2,6-Dichloro-3*H*-pyrido[3,4-*d*]pyrimidine-4-one;
2-(2,6-Dichloro-4-oxo-4*H*-pyrido[3,4-*d*]pyrimidin-3-ylmethyl)-benzonitrile;
2-[2-(3-(*R*)-Amino-piperidin-1-yl)-4-oxo-6-pyrrolidin-1-yl-4*H*-pyrido[3,4-*d*]pyrimidin-3-ylmethyl]-benzonitrile;
2-[(*R*)-3-Amino-piperidin-1-yl]-6-fluoro-3-(2-trifluoromethyl-benzyl)-3*H*-quinazolin-4-one;
2-Chloro-6-fluoro-3-(2-trifluoromethyl-benzyl)-3*H*-quinazolin-4-one;
2-{2-[(*R*)-3-Amino-piperidin-1-yl]-7-isopropyl-6-oxo-6,7-dihydro-purin-1-ylmethyl}-benzonitrile;
2-[2-(3-Amino-azepan-1-yl)-6-oxo-6,7-dihydro-purin-1-ylmethyl]-benzonitrile;

2-{2-[(R)-3-Amino-piperidin-1-yl]-7-benzyl-6-oxo-6-hydro-purin-1-ylmethyl}-benzonitrile;

2-{2-[(R)-3-Amino-piperidin-1-yl]-9-(2-cyano-benzyl)-6-oxo-6-hydro-purin-1-ylmethyl}-benzonitrile;

2-{2-[(R)-3-Amino-piperidin-1-yl]-6-oxo-9-propyl-6,9-dihydro-purin-1-ylmethyl}-benzonitrile;

2-{2-[(R)-3-Amino-piperidin-1-yl]-6-oxo-7-propyl-6,7-dihydro-purin-1-ylmethyl}-benzonitrile;

2-Chloro-9-propyl-1,9-dihydro-purin-6-one;

2-Chloro-7-propyl-1,7-dihydro-purin-6-one;

2-(2-Chloro-6-oxo-9-propyl-6,9-dihydro-purin-1-ylmethyl)-benzonitrile;

2-(2-Chloro-6-oxo-7-propyl-6,7-dihydro-purin-1-ylmethyl)-benzonitrile;

2-{2-[(R)-(3-Amino-piperidin-1-yl)]-9-isopropyl-6-oxo-8-trifluoromethyl-6,9-dihydro-purin-1-ylmethyl}-benzonitrile;

6-Chloro-N4-isopropyl-pyrimidine-2,4,5-triamine;

6-Chloro-9-isopropyl-8-trifluoromethyl-9H-purin-2-ylamine;

2-(2-Amino-9-isopropyl-6-oxo-8-trifluoromethyl-6,9-dihydro-purin-1-ylmethyl)-benzonitrile;

2-(2-Bromo-9-isopropyl-6-oxo-8-trifluoromethyl-6,9-dihydro-purin-1-ylmethyl)-benzonitrile;

2-[2-(3-(R)-Amino-piperidin-1-yl)-6-bromo-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile;

6-Bromo-1H-quinazoline-2,4-dione;

6-Bromo-2-chloro-3H-quinazolin-4-one;

2-(6-Bromo-2-chloro-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile;

2-[2-(3-(R)-Amino-piperidin-1-yl)-6-bromo-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile, TFA salt;

2-[2-(3-(R)-Amino-pyrrolidin-1-yl)-6-bromo-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile, TFA salt;

2-[2-(3-(R)-Amino-piperidin-1-yl)-6,8-dichloro-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile;

6,8-Dichloro-1H-quinazoline-2,4-dione;

2,6,8-Trichloro-3H-quinazolin-4-one;

2-(2,6,8-Trichloro-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile;

2-[2-(3-(R)-Amino-piperidin-1-yl)-6-methoxy-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile;

6-Methoxy-1H-quinazoline-2,4-dione;

2,4-Dichloro-6-methoxy-quinazoline;

2-Chloro-6-methoxy-3H-quinazolin-4-one;

2-(2-Chloro-6-methoxy-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile;

2-[2-(3-(R)-Amino-piperidin-1-yl)-6-fluoro-4-oxo-4H-quinazolin-3-ylmethyl]-benzamide;

2-[2-(3-(R)-Amino-piperidin-1-yl)-6-fluoro-7-morpholin-4-yl-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile;

6,7-Difluoro-1H-quinazoline-2,4-dione;

6-Fluoro-7-morpholin-4-yl-1H-quinazoline-2,4-dione;

2,4-Dichloro-6-fluoro-7-morpholin-4-yl-quinazoline;

2-Chloro-6-fluoro-7-morpholin-4-yl-3H-quinazolin-4-one;

2-(2-Chloro-6-fluoro-7-morpholin-4-yl-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile;

2-[2-(3-Amino-piperidin-1-yl)-6-fluoro-4-oxo-4H-quinazolin-3-ylmethyl]-benzamide;

2-[3-(R)-Amino-piperidin-1-yl]-6-fluoro-3-(2-trifluoromethyl-benzyl)-3H-quinazolin-4-one;

2-Aminomethyl-3-phenyl-3H-quinazolin-4-one;

2-Ethylaminomethyl-3-phenyl-3H-quinazolin-4-one;

[(4-Oxo-3-phenyl-3,4-dihydro-quinazolin-2-ylmethyl)-amino]-acetic acid methyl ester;

[(4-Oxo-3-phenyl-3,4-dihydro-quinazolin-2-ylmethyl)-amino]-acetic acid;

2-Aminomethyl-3-(2,4-dichloro-phenyl)-3H-quinazolin-4-one;

2-Aminomethyl-3-(2-chloro-phenyl)-3H-quinazolin-4-one;

2-Aminomethyl-3-(4-chloro-phenyl)-3H-quinazolin-4-one;

2-(3-Amino-piperidin-1-yl)-6,7-dimethoxy-3-(2-nitro-benzyl)-3H-quinazolin-4-one;
2-[2-(3-Amino-piperidin-1-yl)-6,7-dimethoxy-4-oxo-4H-quinazolin-3-ylmethyl]-benzoic acid ethyl ester;
2-[2-(3-Amino-piperidin-1-yl)-6-fluoro-4-oxo-4H-quinazolin-3-ylmethyl]-benzoic acid ethyl ester;
2-[2-(3-Amino-piperidin-1-yl)-6,7-dimethoxy-4-oxo-4H-quinazolin-3-ylmethyl]-benzoic acid;
2-[2-(3-Amino-piperidin-1-yl)-6-fluoro-4-oxo-4H-quinazolin-3-ylmethyl]-benzoic acid;
and
2-(6,7-Dimethoxy-4-oxo-2-piperidin-1-yl-4H-quinazolin-3-ylmethyl)-benzonitrile.

[0254] In another embodiment, the present invention provides the compounds in the form of a pharmaceutically acceptable salt.

[0255] In yet another embodiment, the present invention provides the compounds present in a mixture of stereoisomers. In yet another embodiment, the present invention provides the compounds as a single stereoisomer.

[0256] In yet another embodiment, the present invention provides pharmaceutical compositions comprising the compound as an active ingredient. In yet another variation, the present invention provides pharmaceutical compositions wherein the composition is a solid formulation adapted for oral administration. In yet another particular variation, the present invention provides pharmaceutical composition wherein the composition is a tablet. In another particular variation, the present invention provides the pharmaceutical composition wherein the composition is a liquid formulation adapted for oral administration. In yet another particular variation, the present invention provides pharmaceutical composition wherein the composition is a liquid formulation adapted for parenteral administration.

[0257] In yet another particular variation, the present invention provides the pharmaceutical composition comprising the compound of the invention wherein the composition is adapted for administration by a route selected from the group consisting of orally, parenterally, intraperitoneally, intravenously, intraarterially, transdermally, sublingually, intramuscularly, rectally, transbuccally, intranasally, liposomally, via inhalation, vaginally, intraocularly, via local delivery (for example by catheter or stent), subcutaneously, intraadiposally, intraarticularly, and intrathecally.

[0258] In another embodiment, the present invention provides a kit comprising a compound of the present invention and instructions which comprise one or more forms of information selected from the group consisting of indicating a disease state for which the compound is to be administered, storage information for the compound, dosing information and instructions regarding how to administer the compound. In another embodiment, the present invention provides the kit that comprises the compound in a multiple dose form.

[0259] In another embodiment, the present invention provides an article of manufacture comprising a compound of the present invention, and packaging materials. In another variation, the packaging material comprises a container for housing the compound. In yet another variation, the invention provides the article of manufacture wherein the container comprises a label indicating one or more members of the group consisting of a disease state for which the compound is to be administered, storage information, dosing information and/or instructions regarding how to administer the composition.

[0260] In another variation, the present invention provides the article of manufacture wherein the article of manufacture comprises the compound in a multiple dose form.

[0261] In another embodiment, the present invention provides a method of inhibiting DPP-IV comprising contacting DPP-IV with a compound according to the present invention.

[0262] In another embodiment, the present invention provides a method of inhibiting DPP-IV comprising causing a compound according to the present invention to be present in a subject in order to inhibit DPP-IV *in vivo*.

[0263] In another embodiment, the present invention provides a method of inhibiting DPP-IV comprising: administering a first compound to a subject that is converted *in vivo* to a second compound wherein the second compound inhibits DPP-IV *in vivo*, the second compound being a compound of the present invention.

[0264] In another embodiment, the present invention provides therapeutic method comprising: administering a compound according to the present invention to a subject.

[0265] In another embodiment, the present invention provides a method of treating a disease state for which DPP-IV possesses activity that contributes to the pathology and/or symptomology of the disease state, the method comprising causing a compound of the present invention to be present in a subject in a therapeutically effective amount for the disease state.

[0266] In another embodiment, the present invention provides a method of treating cancer in a patient in need thereof, comprising administering to said patient a therapeutically effective amount of a compound according to the present invention.

[0267] In another embodiment, the present invention provides a method of treating a disease where the disease is type I or type II diabetes.

[0268] In another embodiment, the present invention provides a method of treating autoimmune disorders such as, but not limited to, rheumatoid arthritis, psoriasis, and multiple sclerosis in a patient in need thereof, comprising administering to said patient a therapeutically effective amount of a compound according to the present invention.

[0269] In yet another embodiment, the present invention provides a method of treating cancer where the cancer treated is colorectal, prostate, breast, thyroid, skin, lung, or head and neck.

[0270] In another embodiment, the present invention provides a method of treating a condition characterized by inadequate lymphocyte or hemapoietic cell activation or concentration in a patient in need thereof, comprising administering to said patient a therapeutically effective amount of a compound according to the present invention.

[0271] In another embodiment, the present invention provides a method of treating HIV infection in a patient in need thereof, comprising administering to said patient a therapeutically effective amount of a compound according to the present invention.

[0272] In yet another embodiment, the present invention provides a method of treating a condition characterized by inadequate lymphocyte or hemapoietic cell activation or concentration in a patient in need thereof, wherein the condition is a side effect of chemotherapy or radiation therapy.

[0273] In yet another embodiment, the present invention provides a method of treating a condition characterized by inadequate lymphocyte or hemapoietic cell activation or concentration in a patient in need thereof, wherein the condition is a result of kidney failure.

[0274] In yet another embodiment, the present invention provides a method of treating a condition characterized by inadequate lymphocyte or hemapoietic cell activation or concentration in a patient in need thereof, wherein the condition is a result of a bone marrow disorder.

[0275] In another embodiment, the present invention provides a method of treating a condition characterized by immunodeficiency symptoms in a patient in need thereof, comprising administering to said patient a therapeutically effective amount of a compound according to the present invention.

[0276] It is noted in regard to all of the embodiments, and any further embodiments, variations, or individual compounds described or claimed herein that all such embodiments, variations, and/or individual compounds are intended to encompass all pharmaceutical acceptable salt forms whether in the form of a single stereoisomer or mixture of stereoisomers unless it is specifically specified otherwise. Similarly, when one or more potentially chiral centers are present in any of the embodiments, variations, and/or individual compounds specified or claimed herein, both possible chiral centers are intended to be encompassed unless it is specifically specified otherwise.

A. Salts, Hydrates, and Prodrugs of DPP-IV Inhibitors

[0277] It should be recognized that the compounds of the present invention may be present and optionally administered in the form of salts, hydrates and prodrugs that are converted *in vivo* into the compounds of the present invention. For example, it is within the scope of the present invention to convert the compounds of the present invention into and use them in the form of their pharmaceutically acceptable salts derived from various organic and inorganic acids and bases in accordance with procedures well known in the art.

[0278] When the compounds of the present invention possess a free base form, the compounds can be prepared as a pharmaceutically acceptable acid addition salt by reacting the free base form of the compound with a pharmaceutically acceptable inorganic or organic acid, *e.g.*, hydrohalides such as hydrochloride, hydrobromide, hydroiodide; other mineral acids and their corresponding salts such as sulfate, nitrate, phosphate, etc.; and alkyl and monoarylsulfonates such as ethanesulfonate, toluenesulfonate and benzenesulfonate; and other organic acids and their corresponding salts such as acetate, tartrate, maleate, succinate, citrate, benzoate, salicylate and ascorbate. Further acid addition salts of the present invention include, but are not limited to: adipate, alginate, arginate, aspartate, bisulfate, bisulfite, bromide, butyrate, camphorate, camphorsulfonate, caprylate, chloride, chlorobenzoate, cyclopentanepropionate, digluconate, dihydrogenphosphate, dinitrobenzoate, dodecylsulfate, fumarate, galacterate (from mucic acid), galacturonate, glucoheptaoate, gluconate, glutamate, glycerophosphate, hemisuccinate, hemisulfate, heptanoate, hexanoate, hippurate, hydrochloride, hydrobromide, hydroiodide, 2-hydroxyethanesulfonate, iodide, isethionate, isobutyrate, lactate, lactobionate, malate, malonate, mandelate, metaphosphate, methanesulfonate, methylbenzoate, monohydrogenphosphate, 2-naphthalenesulfonate, nicotinate, nitrate, oxalate,

oleate, pamoate, pectinate, persulfate, phenylacetate, 3-phenylpropionate, phosphate, phosphonate and phthalate. It should be recognized that the free base forms will typically differ from their respective salt forms somewhat in physical properties such as solubility in polar solvents, but otherwise the salts are equivalent to their respective free base forms for the purposes of the present invention.

[0279] When the compounds of the present invention possess a free acid form, a pharmaceutically acceptable base addition salt can be prepared by reacting the free acid form of the compound with a pharmaceutically acceptable inorganic or organic base. Examples of such bases are alkali metal hydroxides including potassium, sodium and lithium hydroxides; alkaline earth metal hydroxides such as barium and calcium hydroxides; alkali metal alkoxides, *e.g.* potassium ethanolate and sodium propanolate; and various organic bases such as ammonium hydroxide, piperidine, diethanolamine and N-methylglutamine. Also included are the aluminum salts of the compounds of the present invention. Further base salts of the present invention include, but are not limited to: copper, ferric, ferrous, lithium, magnesium, manganic, manganous, potassium, sodium and zinc salts. Organic base salts include, but are not limited to, salts of primary, secondary and tertiary amines, substituted amines including naturally occurring substituted amines, cyclic amines and basic ion exchange resins, *e.g.*, arginine, betaine, caffeine, chlorprocaine, choline, N,N'-dibenzylethylenediamine (benzathine), dicyclohexylamine, diethylamine, 2-diethylaminoethanol, 2-dimethylaminoethanol, ethanolamine, ethylenediamine, N-ethylmorpholine, N-ethylpiperidine, glucamine, glucosamine, histidine, hydrabamine, iso-propylamine, lidocaine, lysine, meglumine, N-methyl-D-glucamine, morpholine, piperazine, piperidine, polyamine resins, procaine, purines, theobromine, triethanolamine, triethylamine, trimethylamine, tripropylamine and tris-(hydroxymethyl)-methylamine (tromethamine). It should be recognized that the free acid forms will typically differ from their respective salt forms somewhat in physical properties such as solubility in polar solvents, but otherwise the salts are equivalent to their respective free acid forms for the purposes of the present invention.

[0280] Compounds of the present invention that comprise basic nitrogen-containing groups may be quaternized with such agents as (C₁₋₄)alkyl halides, *e.g.*, methyl, ethyl, iso-propyl and tert-butyl chlorides, bromides and iodides; di (C₁₋₄)alkyl sulfates, *e.g.*, dimethyl, diethyl and diamyl sulfates; (C₁₀₋₁₈)alkyl halides, *e.g.*, decyl, dodecyl, lauryl, myristyl and stearyl chlorides, bromides and iodides;

and aryl (C₁₋₄)alkyl halides, *e.g.*, benzyl chloride and phenethyl bromide. Such salts permit the preparation of both water-soluble and oil-soluble compounds of the present invention.

[0281] *N*-oxides of compounds according to the present invention can be prepared by methods known to those of ordinary skill in the art. For example, *N*-oxides can be prepared by treating an unoxidized form of the compound with an oxidizing agent (*e.g.*, trifluoroperacetic acid, permaleic acid, perbenzoic acid, peracetic acid, *meta*-chloroperoxybenzoic acid, or the like) in a suitable inert organic solvent (*e.g.*, a halogenated hydrocarbon such as dichloromethane) at approximately 0 °C. Alternatively, the *N*-oxides of the compounds can be prepared from the *N*-oxide of an appropriate starting material.

[0282] Prodrug derivatives of compounds according to the present invention can be prepared by modifying substituents of compounds of the present invention that are then converted *in vivo* to a different substituent. It is noted that in many instances, the prodrugs themselves also fall within the scope of the range of compounds according to the present invention. For example, prodrugs can be prepared by reacting a compound with a carbamylating agent (*e.g.*, 1,1-acyloxyalkylcarbonochloridate, *para*-nitrophenyl carbonate, or the like) or an acylating agent. Further examples of methods of making prodrugs are described in Saulnier *et al.* (1994), *Bioorganic and Medicinal Chemistry Letters*, Vol. 4, p. 1985.

[0283] Protected derivatives of compounds of the present invention can also be made. Examples of techniques applicable to the creation of protecting groups and their removal can be found in T.W. Greene, *Protecting Groups in Organic Synthesis*, 3rd edition, John Wiley & Sons, Inc. 1999.

[0284] Compounds of the present invention may also be conveniently prepared, or formed during the process of the invention, as solvates (*e.g.* hydrates). Hydrates of compounds of the present invention may be conveniently prepared by recrystallization from an aqueous/organic solvent mixture, using organic solvents such as dioxin, tetrahydrofuran or methanol.

[0285] A "pharmaceutically acceptable salt", as used herein, is intended to encompass any compound according to the present invention that is utilized in the form of a salt thereof, especially where the salt confers on the compound improved pharmacokinetic properties as compared to the free form of compound or a different salt form of the compound. The pharmaceutically acceptable salt form may also initially confer desirable pharmacokinetic properties on the compound that it did

not previously possess, and may even positively affect the pharmacodynamics of the compound with respect to its therapeutic activity in the body. An example of a pharmacokinetic property that may be favorably affected is the manner in which the compound is transported across cell membranes, which in turn may directly and positively affect the absorption, distribution, biotransformation and excretion of the compound. While the route of administration of the pharmaceutical composition is important, and various anatomical, physiological and pathological factors can critically affect bioavailability, the solubility of the compound is usually dependent upon the character of the particular salt form thereof, which it utilized. One of skill in the art will appreciate that an aqueous solution of the compound will provide the most rapid absorption of the compound into the body of a subject being treated, while lipid solutions and suspensions, as well as solid dosage forms, will result in less rapid adsorption of the compound.

3. INDICATIONS FOR USE OF DPP-IV INHIBITORS

[0286] DPP-IV is believed to contribute to the pathology and/or symptomology of several different diseases such that reduction of the activity of DPP-IV in a subject through inhibition may be used to therapeutically address these disease states. Examples of various diseases that may be treated using the DPP-IV inhibitors of the present invention are described herein. It is noted that additional diseases beyond those disclosed herein may be later identified as the biological roles that DPP-IV plays in various pathways becomes more fully understood.

[0287] One set of indications that DPP-IV inhibitors of the present invention may be used to treat are those involving the prevention and treatment of diabetes and obesity, in particular type 2 diabetes mellitus, diabetic dislipidemia, conditions of impaired glucose tolerance (IGT), conditions of impaired fasting plasma glucose (IFG), metabolic acidosis, ketosis, appetite regulation and obesity.

[0288] DPP-IV inhibitors of the present invention may also be used as immunosuppressants (or cytokine release suppressant drugs) for the treatment of among other things: organ transplant rejection; autoimmune diseases such as inflammatory bowel disease, multiple sclerosis and rheumatoid arthritis; and the treatment of AIDS.

[0289] DPP-IV inhibitors of the present invention may also be used for treating various cancers including breast cancer, lung cancer and prostate cancer.

[0290] DPP-IV inhibitors of the present invention may also be used to treat dermatological diseases such as psoriasis, rheumatoid arthritis (RA) and lichen planus.

[0291] DPP-IV inhibitors of the present invention may also be used to treat infertility and amenorrhea.

[0292] DPP-IV inhibitors of the present invention may also be used to modulate cleavage of various cytokines (stimulating hematopoietic cells), growth factors and neuropeptides. For example, such conditions occur frequently in patients who are immunosuppressed, for example, as a consequence of chemotherapy and/or radiation therapy for cancer.

[0293] DPP-IV inhibitors of the present invention may also be used prevent or reduce cleavage of N-terminal Tyr-Ala from growth hormone-releasing factor. Accordingly, these inhibitors may be used in the treatment of short stature due to growth hormone deficiency (Dwarfism) and for promoting GH-dependent tissue growth or re-growth.

[0294] DPP-IV inhibitors of the present invention may also be used to address disease states associated with cleavage of neuropeptides and thus may be useful for the regulation or normalization of neurological disorders.

[0295] For oncology indications, DPP-IV inhibitors of the present invention may be used in conjunction with other agents to inhibit undesirable and uncontrolled cell proliferation. Examples of other anti-cell proliferation agents that may be used in conjunction with the DPP-IV inhibitors of the present invention include, but are not limited to, retinoid acid and derivatives thereof, 2-methoxyestradiol, ANGIOSTATIN™ protein, ENDOSTATIN™ protein, suramin, squalamine, tissue inhibitor of metalloproteinase-1, tissue inhibitor of metalloproteinase-2, plasminogen activator inhibitor-1, plasminogen activator inhibitor-2, cartilage-derived inhibitor, paclitaxel, platelet factor 4, protamine sulfate (clupeine), sulfated chitin derivatives (prepared from queen crab shells), sulfated polysaccharide peptidoglycan complex (sp-pg), staurosporine, modulators of matrix metabolism, including for example, proline analogs ((1-azetidine-2-carboxylic acid (LACA)), cishydroxyproline, d,l-3,4-dehydroproline, thiaproline, beta.-aminopropionitrile fumarate, 4-propyl-5-(4-pyridinyl)-2(3H)-oxazolone, methotrexate, mitoxantrone, heparin, interferons, 2 macroglobulin-serum, chimp-3, chymostatin, beta.-cyclodextrin tetradecasulfate, eponemycin; fumagillin, gold sodium thiomalate, d-penicillamine (CDPT), beta.-1-anticollagenase-serum, alpha.2-antiplasmin, bisantrene, lobenzarit disodium, n-2-carboxyphenyl-4-chloroanthronilic acid disodium or "CCA", thalidomide; angostatic

steroid, carboxyaminoimidazole; metalloproteinase inhibitors such as BB94. Other anti-angiogenesis agents that may be used include antibodies, preferably monoclonal antibodies against these angiogenic growth factors: bFGF, aFGF, FGF-5, VEGF isoforms, VEGF-C, HGF/SF and Ang-1/Ang-2. Ferrara N. and Alitalo, K. "Clinical application of angiogenic growth factors and their inhibitors" (1999) Nature Medicine 5:1359-1364.

4. COMPOSITIONS COMPRISING DPP-IV INHIBITORS

[0296] A wide variety of compositions and administration methods may be used in conjunction with the DPP-IV inhibitors of the present invention. Such compositions may include, in addition to the DPP-IV inhibitors of the present invention, conventional pharmaceutical excipients, and other conventional, pharmaceutically inactive agents. Additionally, the compositions may include active agents in addition to the DPP-IV inhibitors of the present invention. These additional active agents may include additional compounds according to the invention, and/or one or more other pharmaceutically active agents.

[0297] The compositions may be in gaseous, liquid, semi-liquid or solid form, formulated in a manner suitable for the route of administration to be used. For oral administration, capsules and tablets are typically used. For parenteral administration, reconstitution of a lyophilized powder, prepared as described herein, is typically used.

[0298] Compositions comprising DPP-IV inhibitors of the present invention may be administered or coadministered orally, parenterally, intraperitoneally, intravenously, intraarterially, transdermally, sublingually, intramuscularly, rectally, transbuccally, intranasally, liposomally, via inhalation, vaginally, intraocularly, via local delivery (for example by catheter or stent), subcutaneously, intraadiposally, intraarticularly, or intrathecally. The compounds and/or compositions according to the invention may also be administered or coadministered in slow release dosage forms.

[0299] The DPP-IV inhibitors and compositions comprising them may be administered or coadministered in any conventional dosage form. Co-administration in the context of this invention is intended to mean the administration of more than one therapeutic agent, one of which includes a DPP-IV inhibitor, in the course of a coordinated treatment to achieve an improved clinical outcome.

Such co-administration may also be coextensive, that is, occurring during overlapping periods of time.

[0300] Solutions or suspensions used for parenteral, intradermal, subcutaneous, or topical application may optionally include one or more of the following components: a sterile diluent, such as water for injection, saline solution, fixed oil, polyethylene glycol, glycerine, propylene glycol or other synthetic solvent; antimicrobial agents, such as benzyl alcohol and methyl parabens; antioxidants, such as ascorbic acid and sodium bisulfite; chelating agents, such as ethylenediaminetetraacetic acid (EDTA); buffers, such as acetates, citrates and phosphates; agents for the adjustment of tonicity such as sodium chloride or dextrose, and agents for adjusting the acidity or alkalinity of the composition, such as alkaline or acidifying agents or buffers like carbonates, bicarbonates, phosphates, hydrochloric acid, and organic acids like acetic and citric acid. Parenteral preparations may optionally be enclosed in ampules, disposable syringes or single or multiple dose vials made of glass, plastic or other suitable material.

[0301] When DPP-IV inhibitors according to the present invention exhibit insufficient solubility, methods for solubilizing the compounds may be used. Such methods are known to those of skill in this art, and include, but are not limited to, using cosolvents, such as dimethylsulfoxide (DMSO), using surfactants, such as TWEEN, or dissolution in aqueous sodium bicarbonate. Derivatives of the compounds, such as prodrugs of the compounds may also be used in formulating effective pharmaceutical compositions.

[0302] Upon mixing or adding DPP-IV inhibitors according to the present invention to a composition, a solution, suspension, emulsion or the like may be formed. The form of the resulting composition will depend upon a number of factors, including the intended mode of administration, and the solubility of the compound in the selected carrier or vehicle. The effective concentration needed to ameliorate the disease being treated may be empirically determined.

[0303] Compositions according to the present invention are optionally provided for administration to humans and animals in unit dosage forms, such as tablets, capsules, pills, powders, dry powders for inhalers, granules, sterile parenteral solutions or suspensions, and oral solutions or suspensions, and oil-water emulsions containing suitable quantities of the compounds, particularly the pharmaceutically acceptable salts, preferably the sodium salts, thereof. The pharmaceutically therapeutically active compounds and derivatives thereof are typically formulated and administered

in unit-dosage forms or multiple-dosage forms. Unit-dose forms, as used herein, refers to physically discrete units suitable for human and animal subjects and packaged individually as is known in the art. Each unit-dose contains a predetermined quantity of the therapeutically active compound sufficient to produce the desired therapeutic effect, in association with the required pharmaceutical carrier, vehicle or diluent. Examples of unit-dose forms include ampoules and syringes individually packaged tablet or capsule. Unit-dose forms may be administered in fractions or multiples thereof. A multiple-dose form is a plurality of identical unit-dosage forms packaged in a single container to be administered in segregated unit-dose form. Examples of multiple-dose forms include vials, bottles of tablets or capsules or bottles of pint or gallons. Hence, multiple dose form is a multiple of unit-doses that are not segregated in packaging.

[0304] In addition to one or more DPP-IV inhibitors according to the present invention, the composition may comprise: a diluent such as lactose, sucrose, dicalcium phosphate, or carboxymethylcellulose; a lubricant, such as magnesium stearate, calcium stearate and talc; and a binder such as starch, natural gums, such as gum acaciagelatin, glucose, molasses, polyvinylpyrrolidone, celluloses and derivatives thereof, povidone, crospovidones and other such binders known to those of skill in the art. Liquid pharmaceutically administrable compositions can, for example, be prepared by dissolving, dispersing, or otherwise mixing an active compound as defined above and optional pharmaceutical adjuvants in a carrier, such as, for example, water, saline, aqueous dextrose, glycerol, glycols, ethanol, and the like, to form a solution or suspension. If desired, the pharmaceutical composition to be administered may also contain minor amounts of auxiliary substances such as wetting agents, emulsifying agents, or solubilizing agents, pH buffering agents and the like, for example, acetate, sodium citrate, cyclodextrine derivatives, sorbitan monolaurate, triethanolamine sodium acetate, triethanolamine oleate, and other such agents. Actual methods of preparing such dosage forms are known in the art, or will be apparent, to those skilled in this art; for example, see Remington's Pharmaceutical Sciences, Mack Publishing Company, Easton, Pa., 15th Edition, 1975. The composition or formulation to be administered will, in any event, contain a sufficient quantity of a DPP-IV inhibitor of the present invention to reduce DPP-IV activity *in vivo*, thereby treating the disease state of the subject.

[0305] Dosage forms or compositions may optionally comprise one or more DPP-IV inhibitors according to the present invention in the range of 0.005% to 100% (weight/weight) with the balance

comprising additional substances such as those described herein. For oral administration, a pharmaceutically acceptable composition may optionally comprise any one or more commonly employed excipients, such as, for example pharmaceutical grades of mannitol, lactose, starch, magnesium stearate, talcum, cellulose derivatives, sodium crosscarmellose, glucose, sucrose, magnesium carbonate, sodium saccharin, talcum. Such compositions include solutions, suspensions, tablets, capsules, powders, dry powders for inhalers and sustained release formulations, such as, but not limited to, implants and microencapsulated delivery systems, and biodegradable, biocompatible polymers, such as collagen, ethylene vinyl acetate, polyanhydrides, polyglycolic acid, polyorthoesters, polylactic acid and others. Methods for preparing these formulations are known to those skilled in the art. The compositions may optionally contain 0.01%-100% (weight/weight) of one or more DPP-IV inhibitors, optionally 0.1-95%, and optionally 1-95%.

[0306] Salts, preferably sodium salts, of the DPP-IV inhibitors may be prepared with carriers that protect the compound against rapid elimination from the body, such as time release formulations or coatings. The formulations may further include other active compounds to obtain desired combinations of properties.

A. Formulations for oral administration

[0307] Oral pharmaceutical dosage forms may be as a solid, gel or liquid. Examples of solid dosage forms include, but are not limited to tablets, capsules, granules, and bulk powders. More specific examples of oral tablets include compressed, chewable lozenges and tablets that may be enteric-coated, sugar-coated or film-coated. Examples of capsules include hard or soft gelatin capsules. Granules and powders may be provided in non-effervescent or effervescent forms. Each may be combined with other ingredients known to those skilled in the art.

[0308] In certain embodiments, DPP-IV inhibitors according to the present invention are provided as solid dosage forms, preferably capsules or tablets. The tablets, pills, capsules, troches and the like may optionally contain one or more of the following ingredients, or compounds of a similar nature: a binder; a diluent; a disintegrating agent; a lubricant; a glidant; a sweetening agent; and a flavoring agent.

[0309] Examples of binders that may be used include, but are not limited to, microcrystalline cellulose, gum tragacanth, glucose solution, acacia mucilage, gelatin solution, sucrose and starch paste.

[0310] Examples of lubricants that may be used include, but are not limited to, talc, starch, magnesium or calcium stearate, lycopodium and stearic acid.

[0311] Examples of diluents that may be used include, but are not limited to, lactose, sucrose, starch, kaolin, salt, mannitol and dicalcium phosphate.

[0312] Examples of glidants that may be used include, but are not limited to, colloidal silicon dioxide.

[0313] Examples of disintegrating agents that may be used include, but are not limited to, crosscarmellose sodium, sodium starch glycolate, alginic acid, corn starch, potato starch, bentonite, methylcellulose, agar and carboxymethylcellulose.

[0314] Examples of coloring agents that may be used include, but are not limited to, any of the approved certified water soluble FD and C dyes, mixtures thereof; and water insoluble FD and C dyes suspended on alumina hydrate.

[0315] Examples of sweetening agents that may be used include, but are not limited to, sucrose, lactose, mannitol and artificial sweetening agents such as sodium cyclamate and saccharin, and any number of spray-dried flavors.

[0316] Examples of flavoring agents that may be used include, but are not limited to, natural flavors extracted from plants such as fruits and synthetic blends of compounds that produce a pleasant sensation, such as, but not limited to peppermint and methyl salicylate.

[0317] Examples of wetting agents that may be used include, but are not limited to, propylene glycol monostearate, sorbitan monooleate, diethylene glycol monolaurate and polyoxyethylene lauryl ether.

[0318] Examples of anti-emetic coatings that may be used include, but are not limited to, fatty acids, fats, waxes, shellac, ammoniated shellac and cellulose acetate phthalates.

[0319] Examples of film coatings that may be used include, but are not limited to, hydroxyethylcellulose, sodium carboxymethylcellulose, polyethylene glycol 4000 and cellulose acetate phthalate.

[0320] If oral administration is desired, the salt of the compound may optionally be provided in a composition that protects it from the acidic environment of the stomach. For example, the composition can be formulated in an enteric coating that maintains its integrity in the stomach and releases the active compound in the intestine. The composition may also be formulated in combination with an antacid or other such ingredient.

[0321] When the dosage unit form is a capsule, it may optionally additionally comprise a liquid carrier such as a fatty oil. In addition, dosage unit forms may optionally additionally comprise various other materials that modify the physical form of the dosage unit, for example, coatings of sugar and other enteric agents.

[0322] Compounds according to the present invention may also be administered as a component of an elixir, suspension, syrup, wafer, sprinkle, chewing gum or the like. A syrup may optionally comprise, in addition to the active compounds, sucrose as a sweetening agent and certain preservatives, dyes and colorings and flavors.

[0323] The DPP-IV inhibitors of the present invention may also be mixed with other active materials that do not impair the desired action, or with materials that supplement the desired action, such as antacids, H₂ blockers, and diuretics. For example, if a compound is used for treating asthma or hypertension, it may be used with other bronchodilators and antihypertensive agents, respectively.

[0324] Examples of pharmaceutically acceptable carriers that may be included in tablets comprising DPP-IV inhibitors of the present invention include, but are not limited to binders, lubricants, diluents, disintegrating agents, coloring agents, flavoring agents, and wetting agents. Enteric-coated tablets, because of the enteric-coating, resist the action of stomach acid and dissolve or disintegrate in the neutral or alkaline intestines. Sugar-coated tablets may be compressed tablets to which different layers of pharmaceutically acceptable substances are applied. Film-coated tablets may be compressed tablets that have been coated with polymers or other suitable coating. Multiple compressed tablets may be compressed tablets made by more than one compression cycle utilizing the pharmaceutically acceptable substances previously mentioned. Coloring agents may also be used in tablets. Flavoring and sweetening agents may be used in tablets, and are especially useful in the formation of chewable tablets and lozenges.

[0325] Examples of liquid oral dosage forms that may be used include, but are not limited to, aqueous solutions, emulsions, suspensions, solutions and/or suspensions reconstituted from non-effervescent granules and effervescent preparations reconstituted from effervescent granules.

[0326] Examples of aqueous solutions that may be used include, but are not limited to, elixirs and syrups. As used herein, elixirs refer to clear, sweetened, hydroalcoholic preparations. Examples of pharmaceutically acceptable carriers that may be used in elixirs include, but are not limited to solvents. Particular examples of solvents that may be used include glycerin, sorbitol, ethyl alcohol and syrup. As used herein, syrups refer to concentrated aqueous solutions of a sugar, for example, sucrose. Syrups may optionally further comprise a preservative.

[0327] Emulsions refer to two-phase systems in which one liquid is dispersed in the form of small globules throughout another liquid. Emulsions may optionally be oil-in-water or water-in-oil emulsions. Examples of pharmaceutically acceptable carriers that may be used in emulsions include, but are not limited to non-aqueous liquids, emulsifying agents and preservatives.

[0328] Examples of pharmaceutically acceptable substances that may be used in non-effervescent granules, to be reconstituted into a liquid oral dosage form, include diluents, sweeteners and wetting agents.

[0329] Examples of pharmaceutically acceptable substances that may be used in effervescent granules, to be reconstituted into a liquid oral dosage form, include organic acids and a source of carbon dioxide.

[0330] Coloring and flavoring agents may optionally be used in all of the above dosage forms.

[0331] Particular examples of preservatives that may be used include glycerin, methyl and propylparaben, benzoic acid, sodium benzoate and alcohol.

[0332] Particular examples of non-aqueous liquids that may be used in emulsions include mineral oil and cottonseed oil.

[0333] Particular examples of emulsifying agents that may be used include gelatin, acacia, tragacanth, bentonite, and surfactants such as polyoxyethylene sorbitan monooleate.

[0334] Particular examples of suspending agents that may be used include sodium carboxymethylcellulose, pectin, tragacanth, Veegum and acacia. Diluents include lactose and sucrose. Sweetening agents include sucrose, syrups, glycerin and artificial sweetening agents such as sodium cyclamate and saccharin.

[0335] Particular examples of wetting agents that may be used include propylene glycol monostearate, sorbitan monooleate, diethylene glycol monolaurate and polyoxyethylene lauryl ether.

[0336] Particular examples of organic acids that may be used include citric and tartaric acid.

[0337] Sources of carbon dioxide that may be used in effervescent compositions include sodium bicarbonate and sodium carbonate. Coloring agents include any of the approved certified water soluble FD and C dyes, and mixtures thereof.

[0338] Particular examples of flavoring agents that may be used include natural flavors extracted from plants such fruits, and synthetic blends of compounds that produce a pleasant taste sensation.

[0339] For a solid dosage form, the solution or suspension, in for example propylene carbonate, vegetable oils or triglycerides, is preferably encapsulated in a gelatin capsule. Such solutions, and the preparation and encapsulation thereof, are disclosed in U.S. Pat. Nos. 4,328,245; 4,409,239; and 4,410,545. For a liquid dosage form, the solution, *e.g.*, for example, in a polyethylene glycol, may be diluted with a sufficient quantity of a pharmaceutically acceptable liquid carrier, *e.g.* water, to be easily measured for administration.

[0340] Alternatively, liquid or semi-solid oral formulations may be prepared by dissolving or dispersing the active compound or salt in vegetable oils, glycols, triglycerides, propylene glycol esters (*e.g.* propylene carbonate) and other such carriers, and encapsulating these solutions or suspensions in hard or soft gelatin capsule shells. Other useful formulations include those set forth in U.S. Pat. Nos. Re 28,819 and 4,358,603.

B. Injectables, solutions and emulsions

[0341] The present invention is also directed to compositions designed to administer the DPP-IV inhibitors of the present invention by parenteral administration, generally characterized by injection, either subcutaneously, intramuscularly or intravenously. Injectables may be prepared in any conventional form, for example as liquid solutions or suspensions, solid forms suitable for solution or suspension in liquid prior to injection, or as emulsions.

[0342] Examples of excipients that may be used in conjunction with injectables according to the present invention include, but are not limited to water, saline, dextrose, glycerol or ethanol. The injectable compositions may also optionally comprise minor amounts of non-toxic auxiliary

substances such as wetting or emulsifying agents, pH buffering agents, stabilizers, solubility enhancers, and other such agents, such as for example, sodium acetate, sorbitan monolaurate, triethanolamine oleate and cyclodextrins. Implantation of a slow-release or sustained-release system, such that a constant level of dosage is maintained (see, *e.g.*, U.S. Pat. No. 3,710,795) is also contemplated herein. The percentage of active compound contained in such parenteral compositions is highly dependent on the specific nature thereof, as well as the activity of the compound and the needs of the subject.

[0343] Parenteral administration of the formulations includes intravenous, subcutaneous and intramuscular administrations. Preparations for parenteral administration include sterile solutions ready for injection, sterile dry soluble products, such as the lyophilized powders described herein, ready to be combined with a solvent just prior to use, including hypodermic tablets, sterile suspensions ready for injection, sterile dry insoluble products ready to be combined with a vehicle just prior to use and sterile emulsions. The solutions may be either aqueous or nonaqueous.

[0344] When administered intravenously, examples of suitable carriers include, but are not limited to physiological saline or phosphate buffered saline (PBS), and solutions containing thickening and solubilizing agents, such as glucose, polyethylene glycol, and polypropylene glycol and mixtures thereof.

[0345] Examples of pharmaceutically acceptable carriers that may optionally be used in parenteral preparations include, but are not limited to aqueous vehicles, nonaqueous vehicles, antimicrobial agents, isotonic agents, buffers, antioxidants, local anesthetics, suspending and dispersing agents, emulsifying agents, sequestering or chelating agents and other pharmaceutically acceptable substances.

[0346] Examples of aqueous vehicles that may optionally be used include Sodium Chloride Injection, Ringers Injection, Isotonic Dextrose Injection, Sterile Water Injection, Dextrose and Lactated Ringers Injection.

[0347] Examples of nonaqueous parenteral vehicles that may optionally be used include fixed oils of vegetable origin, cottonseed oil, corn oil, sesame oil and peanut oil.

[0348] Antimicrobial agents in bacteriostatic or fungistatic concentrations may be added to parenteral preparations, particularly when the preparations are packaged in multiple-dose containers and thus designed to be stored and multiple aliquots to be removed. Examples of antimicrobial

agents that may used include phenols or cresols, mercurials, benzyl alcohol, chlorobutanol, methyl and propyl p-hydroxybenzoic acid esters, thimerosal, benzalkonium chloride and benzethonium chloride.

[0349] Examples of isotonic agents that may be used include sodium chloride and dextrose. Examples of buffers that may be used include phosphate and citrate. Examples of antioxidants that may be used include sodium bisulfate. Examples of local anesthetics that may be used include procaine hydrochloride. Examples of suspending and dispersing agents that may be used include sodium carboxymethylcellulose, hydroxypropyl methylcellulose and polyvinylpyrrolidone. Examples of emulsifying agents that may be used include Polysorbate 80 (TWEEN 80). A sequestering or chelating agent of metal ions include EDTA.

[0350] Pharmaceutical carriers may also optionally include ethyl alcohol, polyethylene glycol and propylene glycol for water miscible vehicles and sodium hydroxide, hydrochloric acid, citric acid or lactic acid for pH adjustment.

[0351] The concentration of a DPP-IV inhibitor in the parenteral formulation may be adjusted so that an injection administers a pharmaceutically effective amount sufficient to produce the desired pharmacological effect. The exact concentration of a DPP-IV inhibitor and/or dosage to be used will ultimately depend on the age, weight and condition of the patient or animal as is known in the art.

[0352] Unit-dose parenteral preparations may be packaged in an ampoule, a vial or a syringe with a needle. All preparations for parenteral administration should be sterile, as is know and practiced in the art.

[0353] Injectables may be designed for local and systemic administration. Typically a therapeutically effective dosage is formulated to contain a concentration of at least about 0.1% w/w up to about 90% w/w or more, preferably more than 1% w/w of the DPP-IV inhibitor to the treated tissue(s). The DPP-IV inhibitor may be administered at once, or may be divided into a number of smaller doses to be administered at intervals of time. It is understood that the precise dosage and duration of treatment will be a function of the location of where the composition is parenterally administered, the carrier and other variables that may be determined empirically using known testing protocols or by extrapolation from *in vivo* or *in vitro* test data. It is to be noted that concentrations and dosage values may also vary with the age of the individual treated. It is to be further understood that for any particular subject, specific dosage regimens may need to be adjusted over time according

to the individual need and the professional judgment of the person administering or supervising the administration of the formulations. Hence, the concentration ranges set forth herein are intended to be exemplary and are not intended to limit the scope or practice of the claimed formulations.

[0354] The DPP-IV inhibitor may optionally be suspended in micronized or other suitable form or may be derivatized to produce a more soluble active product or to produce a prodrug. The form of the resulting mixture depends upon a number of factors, including the intended mode of administration and the solubility of the compound in the selected carrier or vehicle. The effective concentration is sufficient for ameliorating the symptoms of the disease state and may be empirically determined.

C. Lyophilized powders

[0355] The DPP-IV inhibitors of the present invention may also be prepared as lyophilized powders, which can be reconstituted for administration as solutions, emulsions and other mixtures. The lyophilized powders may also be formulated as solids or gels.

[0356] Sterile, lyophilized powder may be prepared by dissolving the compound in a sodium phosphate buffer solution containing dextrose or other suitable excipient. Subsequent sterile filtration of the solution followed by lyophilization under standard conditions known to those of skill in the art provides the desired formulation. Briefly, the lyophilized powder may optionally be prepared by dissolving dextrose, sorbitol, fructose, corn syrup, xylitol, glycerin, glucose, sucrose or other suitable agent, about 1-20%, preferably about 5 to 15%, in a suitable buffer, such as citrate, sodium or potassium phosphate or other such buffer known to those of skill in the art at, typically, about neutral pH. Then, a DPP-IV inhibitor is added to the resulting mixture, preferably above room temperature, more preferably at about 30-35 °C, and stirred until it dissolves. The resulting mixture is diluted by adding more buffer to a desired concentration. The resulting mixture is sterile filtered or treated to remove particulates and to insure sterility, and apportioned into vials for lyophilization. Each vial may contain a single dosage or multiple dosages of the DPP-IV inhibitor.

D. Topical administration

[0357] The DPP-IV inhibitors of the present invention may also be administered as topical mixtures. Topical mixtures may be used for local and systemic administration. The resulting mixture may be a solution, suspension, emulsions or the like and are formulated as creams, gels,

ointments, emulsions, solutions, elixirs, lotions, suspensions, tinctures, pastes, foams, aerosols, irrigations, sprays, suppositories, bandages, dermal patches or any other formulations suitable for topical administration.

[0358] The DPP-IV inhibitors may be formulated as aerosols for topical application, such as by inhalation (see, U.S. Pat. Nos. 4,044,126, 4,414,209, and 4,364,923, which describe aerosols for delivery of a steroid useful for treatment inflammatory diseases, particularly asthma). These formulations for administration to the respiratory tract can be in the form of an aerosol or solution for a nebulizer, or as a microfine powder for insufflation, alone or in combination with an inert carrier such as lactose. In such a case, the particles of the formulation will typically have diameters of less than 50 microns, preferably less than 10 microns.

[0359] The DPP-IV inhibitors may also be formulated for local or topical application, such as for topical application to the skin and mucous membranes, such as in the eye, in the form of gels, creams, and lotions and for application to the eye or for intracisternal or intraspinal application. Topical administration is contemplated for transdermal delivery and also for administration to the eyes or mucosa, or for inhalation therapies. Nasal solutions of the DPP-IV inhibitor alone or in combination with other pharmaceutically acceptable excipients can also be administered.

E. Formulations for other routes of administration

[0360] Depending upon the disease state being treated, other routes of administration, such as topical application, transdermal patches, and rectal administration, may also be used. For example, pharmaceutical dosage forms for rectal administration are rectal suppositories, capsules and tablets for systemic effect. Rectal suppositories are used herein mean solid bodies for insertion into the rectum that melt or soften at body temperature releasing one or more pharmacologically or therapeutically active ingredients. Pharmaceutically acceptable substances utilized in rectal suppositories are bases or vehicles and agents to raise the melting point. Examples of bases include cocoa butter (theobroma oil), glycerin-gelatin, carbowax, (polyoxyethylene glycol) and appropriate mixtures of mono-, di- and triglycerides of fatty acids. Combinations of the various bases may be used. Agents to raise the melting point of suppositories include spermaceti and wax. Rectal suppositories may be prepared either by the compressed method or by molding. The typical weight of a rectal suppository is about 2 to 3 gm. Tablets and capsules for rectal administration may be

manufactured using the same pharmaceutically acceptable substance and by the same methods as for formulations for oral administration.

F. Examples of Formulations

[0361] The following are particular examples of oral, intravenous and tablet formulations that may optionally be used with compounds of the present invention. It is noted that these formulations may be varied depending on the particular compound being used and the indication for which the formulation is going to be used.

ORAL FORMULATION

Compound of the Present Invention	10-100 mg
Citric Acid Monohydrate	105 mg
Sodium Hydroxide	18 mg
Flavoring	
Water	q.s. to 100 mL

INTRAVENOUS FORMULATION

Compound of the Present Invention	0.1-10 mg
Dextrose Monohydrate	q.s. to make isotonic
Citric Acid Monohydrate	1.05 mg
Sodium Hydroxide	0.18 mg
Water for Injection	q.s. to 1.0 mL

TABLET FORMULATION

Compound of the Present Invention	1%
Microcrystalline Cellulose	73%
Stearic Acid	25%
Colloidal Silica	1%.

5. KITS COMPRISING DPP-IV INHIBITORS

[0362] The invention is also directed to kits and other articles of manufacture for treating diseases associated with DPP-IV. It is noted that diseases are intended to cover all conditions for which the DPP-IV possesses activity that contributes to the pathology and/or symptomology of the condition.

[0363] In one embodiment, a kit is provided that comprises a composition comprising at least one DPP-IV inhibitor of the present invention in combination with instructions. The instructions may indicate the disease state for which the composition is to be administered, storage information, dosing information and/or instructions regarding how to administer the composition. The kit may also comprise packaging materials. The packaging material may comprise a container for housing the composition. The kit may also optionally comprise additional components, such as syringes for administration of the composition. The kit may comprise the composition in single or multiple dose forms.

[0364] In another embodiment, an article of manufacture is provided that comprises a composition comprising at least one DPP-IV inhibitor of the present invention in combination with packaging materials. The packaging material may comprise a container for housing the composition. The container may optionally comprise a label indicating the disease state for which the composition is to be administered, storage information, dosing information and/or instructions regarding how to administer the composition. The kit may also optionally comprise additional components, such as syringes for administration of the composition. The kit may comprise the composition in single or multiple dose forms.

[0365] It is noted that the packaging material used in kits and articles of manufacture according to the present invention may form a plurality of divided containers such as a divided bottle or a divided foil packet. The container can be in any conventional shape or form as known in the art which is made of a pharmaceutically acceptable material, for example a paper or cardboard box, a glass or plastic bottle or jar, a re-sealable bag (for example, to hold a "refill" of tablets for placement into a different container), or a blister pack with individual doses for pressing out of the pack according to a therapeutic schedule. The container that is employed will depend on the exact dosage form involved, for example a conventional cardboard box would not generally be used to hold a liquid suspension. It is feasible that more than one container can be used together in a single package to market a single dosage form. For example, tablets may be contained in a bottle that is in turn contained within a box. Typically the kit includes directions for the administration of the separate components. The kit form is particularly advantageous when the separate components are preferably administered in different dosage forms (*e.g.*, oral, topical, transdermal and parenteral), are administered at different dosage intervals, or when titration of the individual components of the combination is desired by the prescribing physician.

[0366] One particular example of a kit according to the present invention is a so-called blister pack. Blister packs are well known in the packaging industry and are being widely used for the packaging of pharmaceutical unit dosage forms (tablets, capsules, and the like). Blister packs generally consist of a sheet of relatively stiff material covered with a foil of a preferably transparent plastic material. During the packaging process recesses are formed in the plastic foil. The recesses have the size and shape of individual tablets or capsules to be packed or may have the size and shape to accommodate multiple tablets and/or capsules to be packed. Next, the tablets or capsules are placed in the recesses accordingly and the sheet of relatively stiff material is sealed against the plastic foil at the face of the foil which is opposite from the direction in which the recesses were formed. As a result, the tablets or capsules are individually sealed or collectively sealed, as desired, in the recesses between the plastic foil and the sheet. Preferably the strength of the sheet is such that the tablets or capsules can be removed from the blister pack by manually applying pressure on the recesses whereby an opening is formed in the sheet at the place of the recess. The tablet or capsule can then be removed via said opening.

[0367] Another specific embodiment of a kit is a dispenser designed to dispense the daily doses one at a time in the order of their intended use. Preferably, the dispenser is equipped with a memory-aid, so as to further facilitate compliance with the regimen. An example of such a memory-aid is a mechanical counter that indicates the number of daily doses that has been dispensed. Another example of such a memory-aid is a battery-powered micro-chip memory coupled with a liquid crystal readout, or audible reminder signal which, for example, reads out the date that the last daily dose has been taken and/or reminds one when the next dose is to be taken.

EXAMPLES

1. Preparation Of DPP-IV Inhibitors

[0368] Various methods may be developed for synthesizing compounds according to the present invention. Representative methods for synthesizing these compounds are provided in the Examples. It is noted, however, that the compounds of the present invention may also be synthesized by other synthetic routes that others may devise.

[0369] It will be readily recognized that certain compounds according to the present invention have atoms with linkages to other atoms that confer a particular stereochemistry to the compound (*e.g.*, chiral centers). It is recognized that synthesis of compounds according to the present invention may result in the creation of mixtures of different stereoisomers (enantiomers, diastereomers). Unless a particular stereochemistry is specified, recitation of a compound is intended to encompass all of the different possible stereoisomers.

[0370] Various methods for separating mixtures of different stereoisomers are known in the art. For example, a racemic mixture of a compound may be reacted with an optically active resolving agent to form a pair of diastereoisomeric compounds. The diastereomers may then be separated in order to recover the optically pure enantiomers. Dissociable complexes may also be used to resolve enantiomers (*e.g.*, crystalline diastereoisomeric salts). Diastereomers typically have sufficiently distinct physical properties (*e.g.*, melting points, boiling points, solubilities, reactivity, etc.) that they can be readily separated by taking advantage of these dissimilarities. For example, diastereomers can typically be separated by chromatography or by separation/resolution techniques based upon differences in solubility. A more detailed description of techniques that can be used to resolve

stereoisomers of compounds from their racemic mixture can be found in Jean Jacques Andre Collet, Samuel H. Wilen, *Enantiomers, Racemates and Resolutions*, John Wiley & Sons, Inc. (1981).

[0371] Compounds according to the present invention can also be prepared as a pharmaceutically acceptable acid addition salt by reacting the free base form of the compound with a pharmaceutically acceptable inorganic or organic acid. Alternatively, a pharmaceutically acceptable base addition salt of a compound can be prepared by reacting the free acid form of the compound with a pharmaceutically acceptable inorganic or organic base. Inorganic and organic acids and bases suitable for the preparation of the pharmaceutically acceptable salts of compounds are set forth in the definitions section of this Application. Alternatively, the salt forms of the compounds can be prepared using salts of the starting materials or intermediates.

[0372] The free acid or free base forms of the compounds can be prepared from the corresponding base addition salt or acid addition salt form. For example, a compound in an acid addition salt form can be converted to the corresponding free base by treating with a suitable base (*e.g.*, ammonium hydroxide solution, sodium hydroxide, and the like). A compound in a base addition salt form can be converted to the corresponding free acid by treating with a suitable acid (*e.g.*, hydrochloric acid, etc).

[0373] The *N*-oxides of compounds according to the present invention can be prepared by methods known to those of ordinary skill in the art. For example, *N*-oxides can be prepared by treating an unoxidized form of the compound with an oxidizing agent (*e.g.*, trifluoroperacetic acid, permaleic acid, perbenzoic acid, peracetic acid, *meta*-chloroperoxybenzoic acid, or the like) in a suitable inert organic solvent (*e.g.*, a halogenated hydrocarbon such as dichloromethane) at approximately 0 °C. Alternatively, the *N*-oxides of the compounds can be prepared from the *N*-oxide of an appropriate starting material.

[0374] Compounds in an unoxidized form can be prepared from *N*-oxides of compounds by treating with a reducing agent (*e.g.*, sulfur, sulfur dioxide, triphenyl phosphine, lithium borohydride, sodium borohydride, phosphorus trichloride, tribromide, or the like) in an suitable inert organic solvent (*e.g.*, acetonitrile, ethanol, aqueous dioxane, or the like) at 0 to 80 °C.

[0375] Prodrug derivatives of the compounds can be prepared by methods known to those of ordinary skill in the art (*e.g.*, for further details see Saulnier *et al.* (1994), *Bioorganic and Medicinal Chemistry Letters*, Vol. 4, p. 1985). For example, appropriate prodrugs can be prepared by reacting a

non-derivatized compound with a suitable carbamylating agent (*e.g.*, 1,1-acyloxyalkylcarbonochloridate, *para*-nitrophenyl carbonate, or the like).

[0376] Protected derivatives of the compounds can be made by methods known to those of ordinary skill in the art. A detailed description of the techniques applicable to the creation of protecting groups and their removal can be found in T.W. Greene, *Protecting Groups in Organic Synthesis*, 3rd edition, John Wiley & Sons, Inc. 1999.

[0377] Compounds according to the present invention may be conveniently prepared, or formed during the process of the invention, as solvates (*e.g.* hydrates). Hydrates of compounds of the present invention may be conveniently prepared by recrystallization from an aqueous/organic solvent mixture, using organic solvents such as dioxin, tetrahydrofuran or methanol.

[0378] Compounds according to the present invention can also be prepared as their individual stereoisomers by reacting a racemic mixture of the compound with an optically active resolving agent to form a pair of diastereoisomeric compounds, separating the diastereomers and recovering the optically pure enantiomer. While resolution of enantiomers can be carried out using covalent diastereomeric derivatives of compounds, dissociable complexes are preferred (*e.g.*, crystalline diastereoisomeric salts). Diastereomers have distinct physical properties (*e.g.*, melting points, boiling points, solubilities, reactivity, etc.) and can be readily separated by taking advantage of these dissimilarities. The diastereomers can be separated by chromatography or, preferably, by separation/resolution techniques based upon differences in solubility. The optically pure enantiomer is then recovered, along with the resolving agent, by any practical means that would not result in racemization. A more detailed description of the techniques applicable to the resolution of stereoisomers of compounds from their racemic mixture can be found in Jean Jacques Andre Collet, Samuel H. Wilen, *Enantiomers, Racemates and Resolutions*, John Wiley & Sons, Inc. (1981).

[0379] As used herein the symbols and conventions used in these processes, schemes and examples are consistent with those used in the contemporary scientific literature, for example, the *Journal of the American Chemical Society* or the *Journal of Biological Chemistry*. Standard single-letter or three-letter abbreviations are generally used to designate amino acid residues, which are assumed to be in the L-configuration unless otherwise noted. Unless otherwise noted, all starting materials were obtained from commercial suppliers and used without further purification.

Specifically, the following abbreviations may be used in the examples and throughout the specification:

g (grams);	mg (milligrams);
L (liters);	mL (milliliters);
μL (microliters);	psi (pounds per square inch);
M (molar);	mM (millimolar);
i.v. (intravenous);	Hz (Hertz);
MHz (megahertz);	mol (moles);
mmol (millimoles);	RT (ambient temperature);
min (minutes);h (hours);	
mp (melting point);	TLC (thin layer chromatography);
Tr (retention time);	RP (reverse phase);
MeOH (methanol);	i-PrOH (isopropanol);
TEA (triethylamine);	TFA (trifluoroacetic acid);
TFAA (trifluoroacetic anhydride);	THF (tetrahydrofuran);
DMSO (dimethylsulfoxide);	EtOAc (ethyl acetate);
DME (1,2-dimethoxyethane);	DCM (dichloromethane);
DCE (dichloroethane);	DMF (N,N-dimethylformamide);
DMPU (N,N'-dimethylpropyleneurea);	CDI (1,1-carbonyldiimidazole);
IBCF (isobutyl chloroformate);	HOAc (acetic acid);
HOSu (N-hydroxysuccinimino);	HOBT (1-hydroxybenzotriazole);
Et ₂ O (diethyl ether);	EDCI (ethylcarbodiimino hydrochloride);
BOC (tert-butyloxycarbonyl);	FMOC (9-fluorenylmethoxycarbonyl);
DCC (dicyclohexylcarbodiimino);	CBZ (benzyloxycarbonyl);
Ac (acetyl);	atm (atmosphere);
TMSE (2-(trimethylsilyl)ethyl);	TMS (trimethylsilyl);
TIPS (triisopropylsilyl);	TBS (t-butyldimethylsilyl);
DMAP (4-dimethylaminopyridine);	Me (methyl);
OMe (methoxy);	Et (ethyl);
Et (ethyl);	tBu (tert-butyl);

HPLC (high pressure liquid chromatography);
BOP (bis(2-oxo-3-oxazolidinyl)phosphinic chloride);
TBAF (tetra-n-butylammonium fluoride);
mCPBA (meta-chloroperbenzoic acid).

[0380] All references to ether or Et₂O are to diethyl ether; brine refers to a saturated aqueous solution of NaCl. Unless otherwise indicated, all temperatures are expressed in °C (degrees Centigrade). All reactions conducted under an inert atmosphere at RT unless otherwise noted.

[0381] ¹H NMR spectra were recorded on a Bruker Avance 400. Chemical shifts are expressed in parts per million (ppm). Coupling constants are in units of hertz (Hz). Splitting patterns describe apparent multiplicities and are designated as s (singlet), d (doublet), t (triplet), q (quartet), m (multiplet), br (broad).

[0382] Low-resolution mass spectra (MS) and compound purity data were acquired on a Waters ZQ LC/MS single quadrupole system equipped with electrospray ionization (ESI) source, UV detector (220 and 254 nm), and evaporative light scattering detector (ELSD). Thin-layer chromatography was performed on 0.25 mm E. Merck silica gel plates (60F-254), visualized with UV light, 5% ethanolic phosphomolybdic acid, Ninhydrin or p-anisaldehyde solution. Flash column chromatography was performed on silica gel (230-400 mesh, Merck).

2. Synthetic Schemes For DPP-IV Inhibitors Of The Present Invention

[0383] DPP-IV inhibitors according to the present invention may be synthesized according to a variety of reaction schemes. Some illustrative schemes are provided herein in the examples. Other reaction schemes could be readily devised by those skilled in the art.

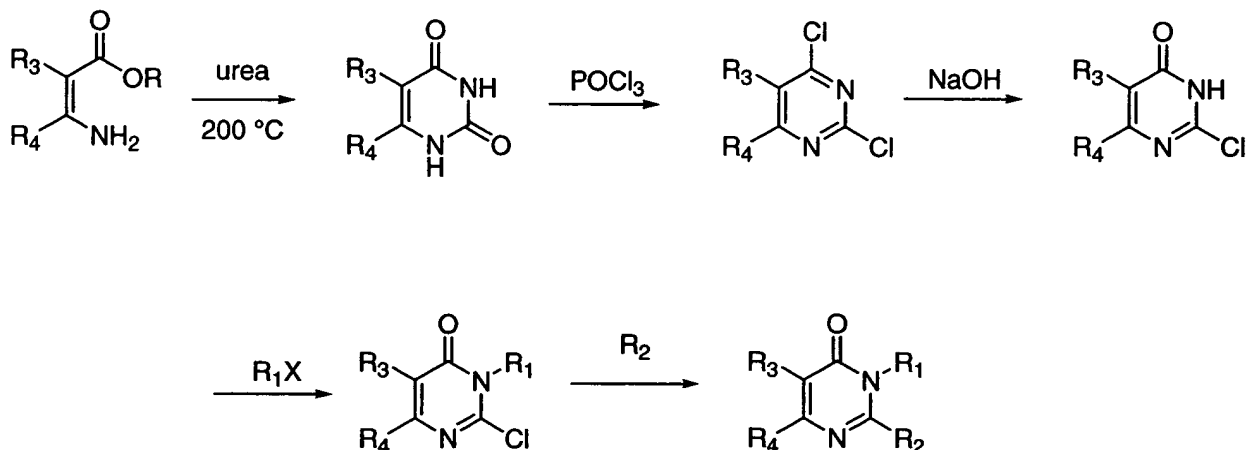
[0384] In the reactions described hereinafter it may be necessary to protect reactive functional groups, for example hydroxy, amino, imino, thio or carboxy groups, where these are desired in the final product, to avoid their unwanted participation in the reactions. Conventional protecting groups may be used in accordance with standard practice, for examples see T.W. Greene and P. G. M. Wuts in "Protective Groups in Organic Chemistry" John Wiley and Sons, 1991.

[0385] Compounds according to the present invention may optionally be synthesized according to the following reaction schemes:

Representative Scheme for the Synthesis of Compounds According to Formula I

where Q=CO:

Scheme 1:

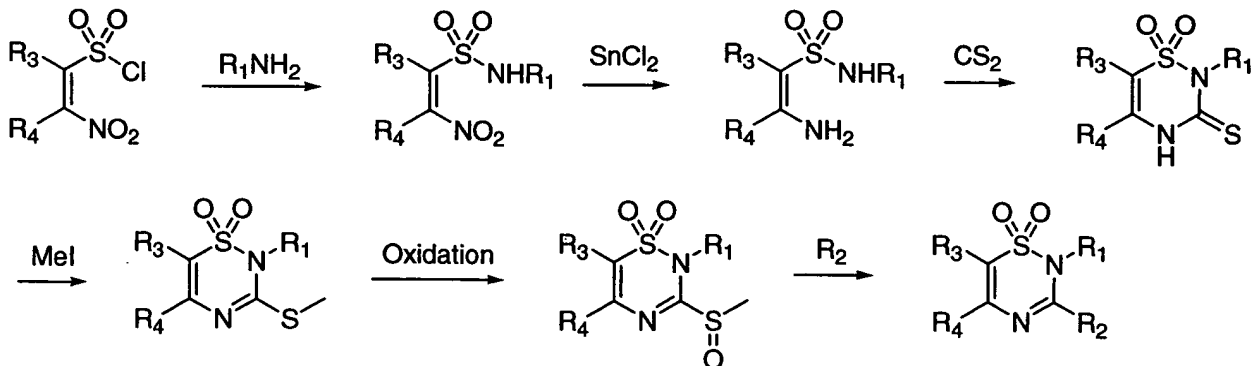


[0386] By varying the R₁X and R₂ groups shown above in this example, a wide variety of different DPP-IV inhibitors according to the present invention may be synthesized.

Representative Scheme for the Synthesis of Compounds According to Formula I

where Q=SO₂:

Scheme 2:



[0387] By varying the R₁, R₂, R₃ and R₄ groups shown above in this example, a wide variety of different DPP-IV inhibitors according to the present invention may be synthesized.

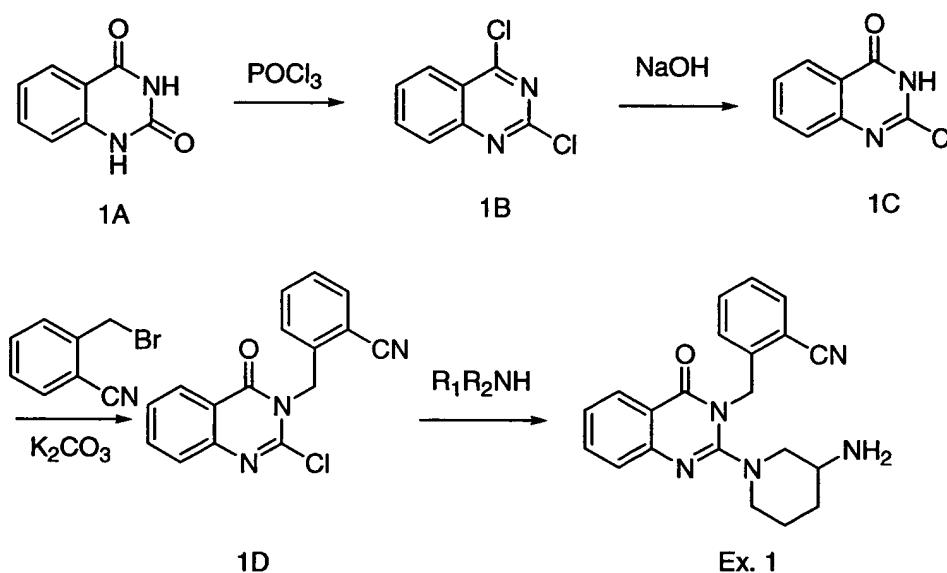
[0388] In each of the above reaction schemes, the various substituents may be selected from among the various substituents otherwise taught herein.

[0389] Descriptions of the syntheses of particular compounds according to the present invention based on the above reaction schemes are set forth herein.

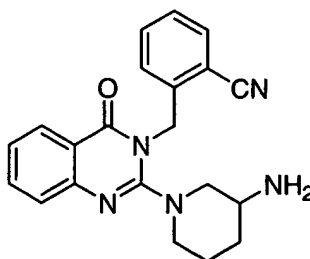
3. Examples Of DPP-IV Inhibitors

[0390] The present invention is further exemplified, but not limited by, the following examples that describe the synthesis of particular compounds according to the invention.

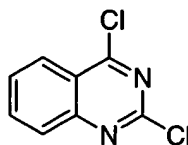
Synthesis of Ex. 1:



Example 1: 2-[2-(3-Amino-piperidin-1-yl)-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile

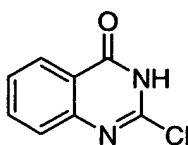


Example 1B: 2,4-Dichloro-quinazoline



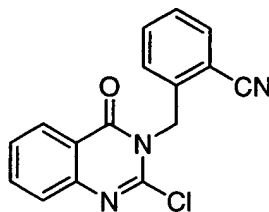
[0391] To 3.2 g of 1H-quinazoline-2,4-dione (**1A**) in 20 mL POCl₃ was added 0.8 mL N,N-dimethylaniline. The mixture was then heated at reflux for 16 hours. Excess POCl₃ was removed *in vacuo*, providing crude product **1B**.

Example 1C: 2-Chloro-3H-quinazolin-4-one



[0392] A mixture of 20 mL of 1N NaOH, 20 mL of THF, and 2 g of **1B** was stirred at room temperature under N₂ for 4 hours. The solution was chilled and adjusted to pH 5 with AcOH. The solids that precipitated were filtered to give 1.62 g (90%) of product **1C**.

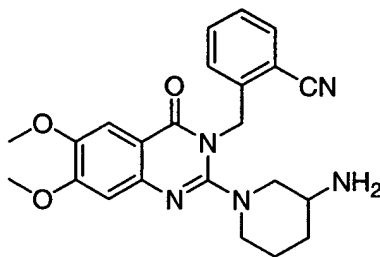
Example 1D: 2-(2-Chloro-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile



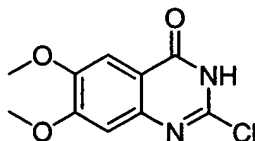
[0393] A mixture of 0.36 g of **1C**, 0.47 g of 2-cyanobenzylbromide and 0.35 g of K₂CO₃ in 10 mL of DMF was stirred over night. The reaction mixture was diluted with water, extracted with ethyl acetate, and dried over MgSO₄. Removal of the solvent gave crude product **1D** (containing O-alkylated product).

[0394] A mixture of 200 mg of crude **1D**, 3 eq. of 3-aminopiperidine dihydrochloride, 5 eq. of NaHCO_3 , and 3 mL of ethanol in a sealed tube was heated to 150°C for 6 hours. After cooling to room temperature and filtering out the inorganic salts, purification via LC/MS afforded 108 mg (45% yield) of product of Example 1. ^1H NMR (400 MHz, CDCl_3): δ 8.05 (d, $J = 7.60$ Hz, 1H), 7.69-7.79 (m, 2H), 7.56-7.62 (m, 2H), 7.37-7.46 (m, 2H), 7.30 (d, $J = 8.0$ Hz, 1H), 5.52 (AB q, $J = 15.2$ Hz, 2H), 3.64-3.71 (m, 1H), 3.55 (br s, 1H), 3.19-3.32 (m, 2H), 2.98-3.08 (m, 1H), 2.10-2.18 (m, 1H), 1.62-1.94 (m, 3H). MS: (ES) $\text{M}+\text{H}$ calc'd for $\text{C}_{21}\text{H}_{21}\text{N}_5\text{O}$, 360; found 360.

Example 2: 2-[2-(3-Amino-piperidin-1-yl)-6,7-dimethoxy-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile

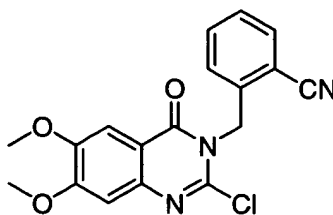


Example 2A: 2-Chloro-6,7-dimethoxy-3H-quinazolin-4-one



[0395] 2,4-Dichloro-6,7-dimethoxy-quinazoline (1.02 g, 3.95 mmol) was converted to the title compound (664 mg, 70%) by the method used for example **1C**. ^1H NMR (400 MHz, DMSO): δ 13.1 (s, 1H), 7.41 (s, 1H), 7.13 (s, 1H), 3.90 (s, 3H), 3.87 (s, 3H). MS: (ES) $\text{M}+\text{H}$ calc'd for $\text{C}_{10}\text{H}_9\text{ClN}_2\text{O}_3$, 241; found 241.

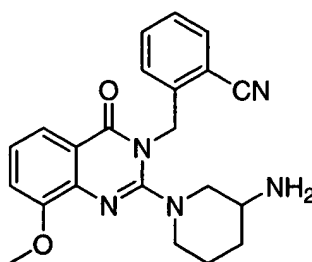
Example 2B: 2-(2-Chloro-6,7-dimethoxy-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile



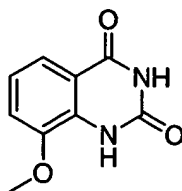
[0396] To a stirred solution of 2A (280 mg, 1.17 mmol) in DME (2 mL) and DMF (0.5 mL) at 0 °C was added NaH (30 mg, 1.23 mmol). After ten minutes, LiBr (203 mg, 2.33 mmol) was added and the mixture was allowed to warm to RT. After 15 minutes, α -bromo-o-tolunitrile (457 mg, 2.33 mmol) was added and the mixture was heated at 65 °C overnight. After cooling, water (10 mL) was added. A precipitate formed. This precipitate was filtered and dried to give 2B which was not further purified.

[0397] **2B** (215 mg, 0.6 mmol) was converted to the title compound by the method used for **Example 1**. The product was recrystallized to give purified **2**, 2-[2-(3-Amino-piperidin-1-yl)-6,7-dimethoxy-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile, (95 mg). ¹H NMR (400 MHz, DMSO): δ 7.84 (dd, J = 0.89, 7.7 Hz, 1H), 7.60 (ddd, J = 1.0, 1.1, 7.7 Hz, 1H), 7.43 (t, J = 7.6 Hz, 1H), 7.32 (s, 1H), 7.05 (d, J = 7.9 Hz), 7.01 (s, 1H), 5.41 (s, 2H), 3.90 (s, 3H), 3.81 (s, 3H), 3.25 (m, 1H), 3.17 (m, 1H), 2.72 (m, 2H), 1.80 (m, 1H), 1.67 (m, 2H), 1.52 (m, 1H), 1.11 (m, 1H). MS: (ES) M+H calc'd for C₂₃H₂₅N₅O₃, 420; found 420.

Example 3: 2-[2-(3-Amino-piperidin-1-yl)-8-methoxy-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile

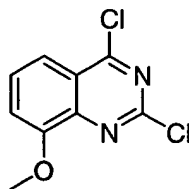


Example 3A: 8-Methoxy-1H-quinazoline-2,4-dione



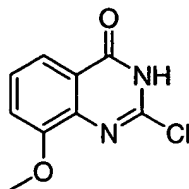
[0398] 2-amino-3-methoxybenzoic acid (842 mg, 5 mmol) and urea (1.5 g, 25 mmol) were heated together at 200 °C for 1.5 hours. The mixture was cooled and triturated with water. The solid was filtered and dried to give **3A** (843 mg, yellow solid, 88%). MS: (ES) M+H calc'd for C₉H₈N₂O₃, 193; found 193.

Example 3B: 2,4-Dichloro-8-methoxy-quinazoline



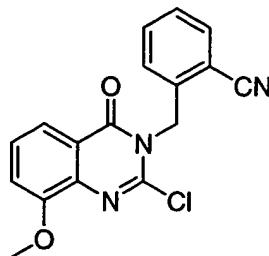
[0399] **3A** (843 mg, 4.39 mmol) was converted to crude **3B** by the method used for **Example 1B**.

Example 3C: 2-Chloro-8-methoxy-3H-quinazolin-4-one



[0400] Crude **3B** was converted to **3C** (388 mg) by the method used for **Example 1C**. MS: (ES) M+H calc'd for C₉H₇ClN₂O₂, 211; found 211.

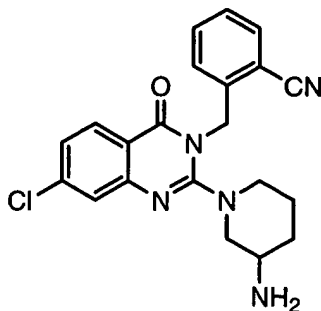
Example 3D: 2-(2-Chloro-8-methoxy-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile



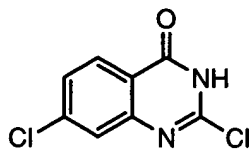
[0401] **3C** (210 mg, 1 mmol) was converted to **3D** by the procedure used for **Example 2B**. MS: (ES) M+H calc'd for C₁₇H₁₂ClN₃O₂, 326; found 326.

[0402] **3D** (230 mg, 0.7 mmol) was converted to **Example 3**, 2-[2-(3-Amino-piperidin-1-yl)-8-methoxy-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile (100 mg, 37%) by the method used for **Example 1**. ¹H NMR (400 MHz, DMSO): δ 7.79 (dd, J = 1.2, 7.9 Hz, 1H), 7.68 (dd, J = 0.98, 7.6 Hz, 1H), 7.47 (ddd, J = 1.2, 1.3, 7.8 Hz, 1H), 7.31 (m, 2H), 7.18 (dd, J = 1.1, 8.0 Hz), 7.03 (d, J = 7.8 Hz, 1H), 5.57 (s, 2H), 4.01 (s, 3H), 3.35 (m, 1H), 3.22 (m, 1H), 2.96 (m, 2H), 2.76 (dd, J = 9.1, 11.9 Hz, 1H), 1.96 (m, 1H), 1.80 (m, 1H), 1.67 (m, 1H), 1.25 (m, 1H). MS: (ES) M+H calc'd for C₂₂H₂₃N₅O₂, 390; found 390.

Example 4: 2-[2-(3-Amino-piperidin-1-yl)-7-chloro-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile, TFA salt

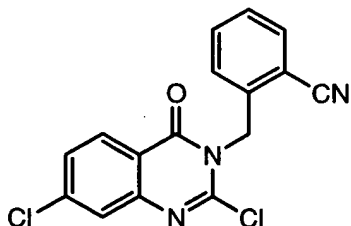


Example 4A: 2,7-Dichloro-3*H*-quinazolin-4-one



[0403] The title compound was prepared from 7-chloro-1*H*-quinazoline-2,4-dione (see Schneller et. al., *J. Org. Chem.*, 46, 8, 1981, 1699-1702) in 58% yield according to the procedures of examples 1*B* and 1*C*. ¹H NMR (400 MHz, DMSO-*d*₆); δ 13.41 (br s, 1H), 8.07 (d, 1H, *J* = 6.3 Hz), 7.70 (d, 1H, *J* = 1.5 Hz), 7.57 (dd, 1H, *J* = 6.3, 1.5 Hz). MS (ES) [*m*+*H*] calculated for C₈H₄N₂OCl₂+H 214.98, 216.97; found 215.07, 217.08.

Example 4B: 2-(2,7-Dichloro-4-oxo-4*H*-quinazolin-3-ylmethyl)-benzonitrile

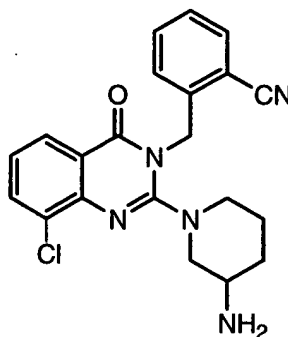


[0404] The title compound was prepared from 2,7-dichloro-3*H*-quinazolin-4-one in 70% yield according to the procedure for 2*B*. ¹H NMR (400 MHz, CDCl₃); δ 8.22 (d, 1H, *J* = 6.3 Hz), 7.74 (dd, 1H, *J* = 5.7, 0.9 Hz), 7.68 (d, 1H, *J* = 0.3 Hz), 7.49-7.57 (m, 2H), 7.43 (t, 1H, *J* = 5.7 Hz), 7.15 (d, 1H, *J* = 5.7 Hz), 5.73 (s, 2H). MS (ES) [*m*+*H*] calculated for C₁₆H₉N₃OCl₂+H 330.02, 332.02; found 329.99, 332.00.

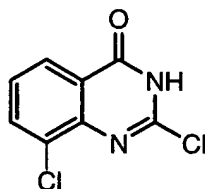
[0405] The title compound, **Example 4**, 2-[2-(3-Amino-piperidin-1-yl)-7-chloro-4-oxo-4*H*-quinazolin-3-ylmethyl]-benzonitrile, TFA salt, was prepared from 2-(2,7-dichloro-4-oxo-4*H*-quinazolin-3-ylmethyl)-benzonitrile in 80% yield according to the procedure for compound 1. ¹H NMR (400 MHz, DMSO-*d*₆); δ 7.90-8.01 (m, 4H), 7.81 (d, 1H, *J* = 5.7 Hz), 7.56-7.64 (m, 2H), 7.38-7.48 (m, 2H), 7.26 (d, 1H, *J* = 5.7 Hz), 5.36 (dd, 2H, *J* = 34.8, 11.4 Hz), 3.52-3.58 (m, 1H), 3.36-3.46

(m, 1H), 3.03-3.24 (m, 2H), 2.87-2.94 (m, 1H), 1.92-1.99 (m, 1H), 1.78-1.85 (m, 1H), 1.50-1.69 (m, 2H). MS (ES) [m+H] calculated for $C_{21}H_{20}N_5OCl+H$ 394.14, 396.14; found 394.02, 395.96.

Example 5: 2-[2-(3-Amino-piperidin-1-yl)-8-chloro-4-oxo-4*H*-quinazolin-3-ylmethyl]-benzonitrile, TFA salt

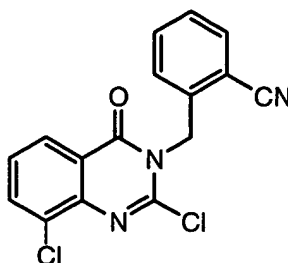


Example 5A: 2,8-Dichloro-3*H*-quinazolin-4-one



[0406] The title compound was prepared from 8-chloro-1*H*-quinazoline-2,4-dione (see Bindra, US4085213) in 37% yield according to the procedures of examples **1B** and **1C**. 1H NMR (400 MHz, DMSO- d_6); δ 13.50 (br s, 1H), 8.04 (dd, 1H, $J = 6.0, 1.2$ Hz), 7.98 (dd, 1H, $J = 6.0, 1.2$ Hz), 7.51 (t, 1H, $J = 6.0$ Hz). MS (ES) [m+H] calculated for $C_8H_4N_2OCl_2+H$ 214.98, 216.97; found 215.07, 217.08.

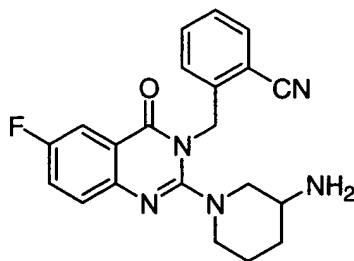
Example 5B: 2-(2,8-Dichloro-4-oxo-4*H*-quinazolin-3-ylmethyl)-benzonitrile



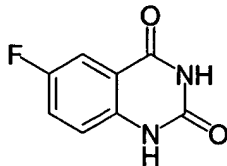
[0407] The title compound was prepared from 2,8-dichloro-3*H*-quinazolin-4-one in 72% yield according to the procedure for **2B**. ¹H NMR (400 MHz, CDCl₃); δ 8.22 (dd, 1H, J = 6.0, 1.2 Hz), 7.89 (dd, 1H, J = 6.0, 1.2 Hz), 7.74 (dd, 1H, J = 6.0, 0.9 Hz), 7.42-7.76 (m, 3H), 7.14 (d, 1H, J = 6.0 Hz), 5.75 (s, 2H). MS (ES) [m+H] calculated for C₁₆H₉N₃OCl₂+H 330.02, 332.02; found 329.93, 331.94.

[0408] The title compound, **Example 5**, 2-[2-(3-Amino-piperidin-1-yl)-8-chloro-4-oxo-4*H*-quinazolin-3-ylmethyl]-benzonitrile, TFA salt, was prepared from 2-(2,8-dichloro-4-oxo-4*H*-quinazolin-3-ylmethyl)-benzonitrile in 76% yield according to the procedure for compound **1**. ¹H NMR (400 MHz, DMSO-*d*₆); δ 7.88-8.02 (m, 5H), 7.81 (dd, 1H, J = 5.7, 0.6 Hz), 7.60 (dt, 1H, J = 5.7, 0.9 Hz), 7.44 (t, 1H, J = 5.7 Hz), 7.27-7.36 (m, 2H), 5.37 (dd, 2H, J = 33.3, 11.4 Hz), 3.60-3.66 (m, 1H), 3.41-3.50 (m, 1H), 3.15-3.25 (m, 2H), 2.90-2.99 (m, 1H), 1.92-1.99 (m, 1H), 1.79-1.87 (m, 1H), 1.51-1.69 (m, 2H). MS (ES) [m+H] calculated for C₂₁H₂₀N₅OCl+H 394.14, 396.14; found 394.04, 396.06.

Example 6: 2-[2-(3-Amino-piperidin-1-yl)-6-fluoro-4-oxo-4*H*-quinazolin-3-ylmethyl]-benzonitrile

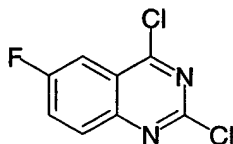


Example 6A: 6-Fluoro-1H-quinazoline-2,4-dione



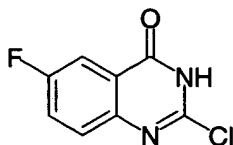
[0409] 2-Amino-6-fluoro-benzoic acid was converted to the title compound by the method used for Example 3A.

Example 6B: 2,4-Dichloro-6-fluoro-quinazoline



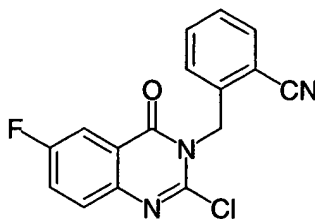
[0410] 6A was converted to the title compound by the method used for Example 1B.

Example 6C: 2-Chloro-6-fluoro-3H-quinazolin-4-one



[0411] 6B was converted to the title compound by the method used for Example 1C.

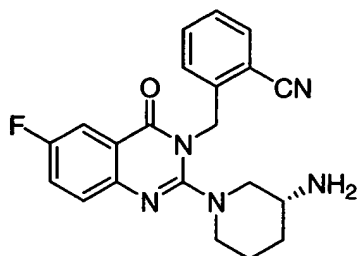
Example 6D: 2-(2-Chloro-6-fluoro-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile



[0412] **6C** was converted to the title compound by the method used for **Example 1D**. ^1H NMR (400 MHz CDCl_3): δ 7.93 (dd, $J = 2.8, 8.0$ Hz, 1H), 7.68-7.75 (m, 2H), 7.50-7.60 (m, 2H), 7.42 (dd, $J = 7.2, 7.6$ Hz, 1H), 7.15 (d, $J = 8.0$ Hz, 1H), 5.74 (s, 2H). MS (ES) [$m+H$] calculated for $\text{C}_{16}\text{H}_9\text{ClFN}_3\text{O}$, 314; found 314.

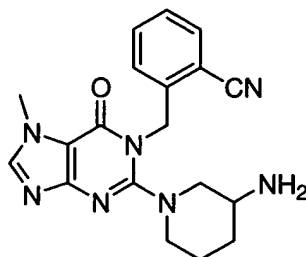
[0413] **6D** was converted to the title compound by the method used for **Example 1**. ^1H NMR (400 MHz CD_3OD): δ 7.52-7.9 (m, 5H), 7.41-7.51 (m, 1H), 7.35 (d, $J = 8.0$ Hz, 1H), 5.44-5.66 (AB q, $J = 16.0$ Hz, 2H), 3.62-3.71 (m, 1H), 3.55-3.60 (m, 1H), 3.19-3.33 (m, 2H), 2.94-3.05 (m, 1H), 2.11-2.20 (m, 1H), 1.60-1.95 (m, 3H). MS (ES) [$m+H$] calculated for $\text{C}_{21}\text{H}_{20}\text{FN}_5\text{O}$, 378; found 378.

Example 6E: (R) 2-[2-(3-Amino-piperidin-1-yl)-6-fluoro-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile TFA salt

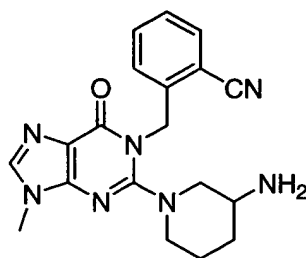


[0414] The (R) enantiomer form of **6D** where was converted to **6E** by the method used for **Example 1**. ^1H NMR (400 MHz CD_3OD) δ 7.52-7.9 (m, 5H), 7.41-7.51 (m, 1H), 7.35 (d, $J = 8.0$ Hz, 1H), 5.44-5.66 (AB q, $J = 16.0$ Hz, 2H), 3.62-3.71 (m, 1H), 3.55-3.60 (m, 1H), 3.19-3.33 (m, 2H), 2.94-3.05 (m, 1H), 2.11-2.20 (m, 1H), 1.60-1.95 (m, 3H). MS (ES) [$m+H$] calculated for $\text{C}_{21}\text{H}_{20}\text{FN}_5\text{O}$, 378; found 378.

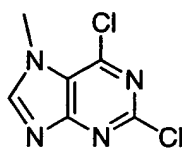
Example 7: 2-[2-(3-Amino-piperidin-1-yl)-7-methyl-6-oxo-6,7-dihydro-purin-1-ylmethyl]-benzonitrile



Example 8: 2-[2-(3-Amino-piperidin-1-yl)-9-methyl-6-oxo-6,9-dihydro-purin-1-ylmethyl]-benzonitrile



Example 7A: 2,6-Dichloro-7-methyl-7H-purine



Example 8A: 2,6-Dichloro-9-methyl-9H-purine

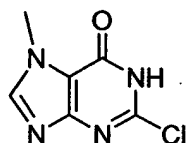


[0415] To a cold solution of 2,6-Dichloro-7H-purine (1g, 5.29 mmol) in DMF (5 mL) was added 60% NaH (233 mg, 5.8 mmol) under N₂. After stirring for 10 min, MeI (910 μ L) was added, the reaction mixture was stirred for 30 min at this temperature and then overnight at room temperature, concentrated and co-evaporated with H₂O to dryness. The residue was suspended in 2 mL cold water and filtered to give crude mixture of **7A** and **8A** in about 1:1 ratio.

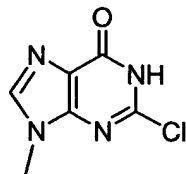
[0416] Selected data for **7A**: NMR (400 MHz DMSO): δ 8.79 (s, 1H), 4.06 (s, 2H).

[0417] Selected data for **8A**: NMR (400 MHz DMSO): δ 8.66 (s, 1H), 3.82 (s, 3H). MS (ES) [m+H] calculated for C₆H₄Cl₂N₄+H, 203; found 203.

Example 7B: 2-Chloro-7-methyl-1,7-dihydro-purin-6-one



Example 8B: 2-Chloro-9-methyl-1,9-dihydro-purin-6-one

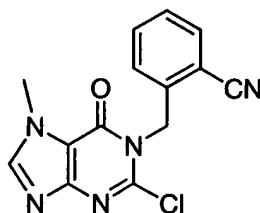


[0418] The crude products **7A** and **8A** were converted to **7B** and **8B** as a mixture by the method used for the preparation of **1C** in 82% yield.

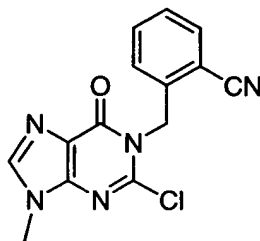
[0419] Selected data for **7B**: NMR (400 MHz DMSO): δ 8.79 (s, 1H), 4.06 (s, 2H).

[0420] Selected data for **8B**: NMR (400 MHz DMSO): δ 8.66 (s, 1H), 3.82 (s, 3H). MS (ES) [m+H] calculated for C₆H₅ClN₄O+H, 185; found 185.

Example 7C: 2-(2-Chloro-7-methyl-6-oxo-6,7-dihydro-purin-1-ylmethyl)-benzonitrile



Example 8C: 2-(2-Chloro-9-methyl-6-oxo-6,9-dihydro-purin-1-ylmethyl)-benzonitrile



[0421] A mixture of title compounds **7C** and **8C** was prepared by the method used in the preparation of **1D**.

[0422] Selected data for **7C**: NMR (400 MHz CDCl_3): δ 8.04 (Bs, 1H), 5.74 (s, 2H), 4.11 (s, 3H).

[0423] Selected data for **8C**: NMR (400 MHz CDCl_3): δ 7.91 (Bs, 1H), 5.77 (s, 2H), 3.85 (s, 3H). MS (ES) [m+H] calculated for $\text{C}_{14}\text{H}_{10}\text{ClN}_5\text{O}+1$, 300; found 300.

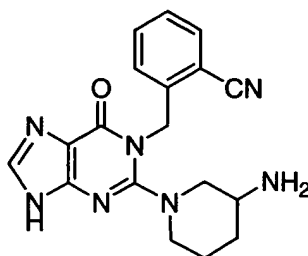
[0424] A mixture of compound **7C** and **8C** was converted by the method used in the preparation of **Example 1** to the title compounds **7** and **8**, which were purified by LC-MS.

[0425] Example 7: NMR (400 MHz $\text{CDCl}_3\text{-CD}_3\text{OD}$ 10:1): δ 7.9 (br s, 1H), 7.63 (d, 1H, $J = 7.2$ Hz), 7.53 (t, 1H, $J = 7.3$ Hz), 7.37 (t, 1H, 7.3Hz), 7.20 (d, 1H, $J = 8.0$ Hz), 5.50-5.38 (AB q, 2H, $J = 15.2$ Hz), 3.78 (s, 3H), 3.60 (br d, 1H, $J = 12.4$ Hz), 3.53 (m, 1H), 3.22 (dd, 1H, $J = 8.4$ and 12 Hz), 3.1 (m, 1H), 2.96 (m, 1H), 2.19 (m, 1H), 1.87 (m, 1H), 1.72 (m, 2H). MS (ES) [m+H] calculated for $\text{C}_{19}\text{H}_{21}\text{N}_7\text{O}+\text{H}$, 364.18; found 364.17.

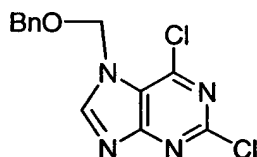
[0426] Example 8: NMR (400 MHz $\text{CDCl}_3\text{-CD}_3\text{OD}$ 10:1): δ 7.91 (br s, 1H), 7.69 (d, 1H, $J = 7.2$ Hz), 7.58 (t, 1H, $J = 7.3$ Hz), 7.42 (t, 1H, 7.3 Hz), 7.20 (d, 1H, $J = 8.0$ Hz), 5.57-5.43 (AB q, 2H,

$J = 15.2$ Hz), 4.02 (s, 3H), 3.56 (br d, 1H, $J = 12.4$ Hz), 3.50 (m, 1H), 3.15 (m, 2H), 2.96 (m, 1H), 2.11 (m, 1H), 1.84 (m, 1H), 1.70 (m, 2H). MS (ES) $[m+H]$ calculated for $C_{19}H_{21}N_7O+H$, 364.18; found 364.17.

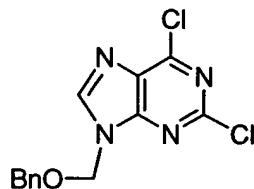
Example 9: 2-{2-[(R)-3-Amino-piperidin-1-yl]-6-oxo-6,7-dihydro-purin-1-ylmethyl}-benzonitrile



Example 9A: 7-Benzyloxymethyl-2,6-dichloro-7H-purine



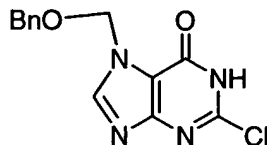
Example 9B: 9-Benzyloxymethyl-2,6-dichloro-9H-purine



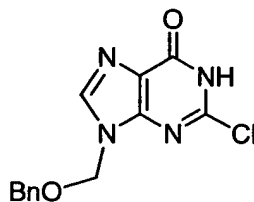
[0427] A mixture of **Example 9A** and **Example 9B** was synthesized from 2,6-Dichloro-7H-purine by the method described in syntheses of **Example 7A** and **8A**.

[0428] **Example 9B:** NMR (400 MHz $CDCl_3$): δ 8.2 (s, 1H), 7.3 (m, 5H), 5.70 (s, 2H), 4.63 (s, 2H). MS (ES) $[m+H]$ calculated for $C_{13}H_{10}Cl_2N_4O+H$, 309; found 309.

Example 9C: 7-Benzyloxymethyl-2-chloro-1,7-dihydro-purin-6-one

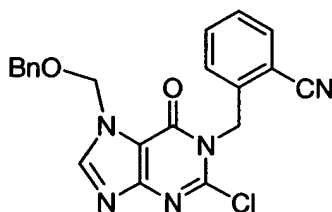


Example 9D: 9-Benzyloxymethyl-2-chloro-1,9-dihydro-purin-6-one

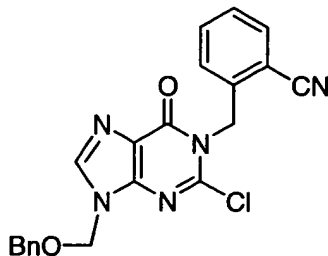


[0429] The mixture of **Example 9A** and **Example 9B** was converted to **Example 9C** and **Example 9D** by the method used in the preparation of **Example 1C**.

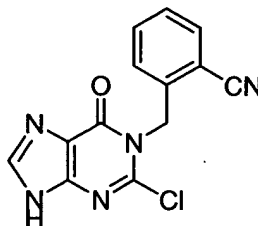
Example 9E: 2-(7-Benzyloxymethyl-2-chloro-6-oxo-6,7-dihydro-purin-1-ylmethyl)-benzonitrile



Example 9F: 2-(9-Benzyloxymethyl-2-chloro-6-oxo-6,9-dihydro-purin-1-ylmethyl)-benzonitrile



Example 9G: 2-(2-Chloro-6-oxo-6,9-dihydro-purin-1-ylmethyl)-benzonitrile



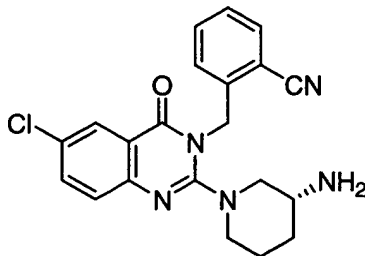
[0430] Alkylation of the mixture of **Example 9C** and **Example 9D** by the method used for **Example 1C** gave a mixture of **Example 9E** and **Example 9F**, which was treated with 4N HCl in dioxane at 40 °C overnight to give **Example 9G**.

[0431] **Example 9G:** NMR (400 MHz CDCl₃): δ 8.02 (br s, 1H), 7.70 (d, 1H, J = 7.6 Hz), 7.53 (t, 1H, J = 7.6 Hz), 7.40 (t, 1H, 7.6Hz), 7.06 (d, 1H, J = 8.0 Hz), 5.72 (s, 2H). MS (ES) [m+H] calculated for C₁₃H₈ClN₅O+H, 286.04; found 286.03.

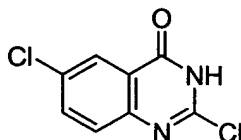
[0432] The title compound of **Example 9**, 2-{2-[(R)-3-Amino-piperidin-1-yl]-6-oxo-6,7-dihydro-purin-1-ylmethyl}-benzonitrile, was prepared from **Example 9G** by the method used in the preparation of **Example 1**.

[0433] **Example 9:** NMR (400 MHz CDCl₃-CD₃OD 10:1): δ 8.05 (s, 1H), 7.59 (d, 1H, J = 7.2 Hz), 7.46 (t, 1H, J = 7.6 Hz), 7.31 (t, 1H, 7.6 Hz), 7.09 (d, 1H, J = 7.2 Hz), 5.50-5.33 (AB q, 2H, J = 15.6 Hz), 3.47 (m, 1H), 3.24 (m, 1H), 3.07 (m, 1H), 2.92 (m, 1H), 2.01 (m, 1H), 1.74 (m, 2H), 1.60(m, 1H). MS (ES) [m+H] calculated for C₁₈H₁₉N₇O+H, 350.2 found 350.2.

Example 10: 2-[2-(3-(*R*)-Amino-piperidin-1-yl)-6-chloro-4-oxo-4*H*-quinazolin-3-ylmethyl]-benzonitrile, TFA salt

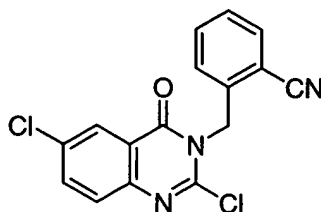


Example 10A: 2,6-Dichloro-3*H*-quinazolin-4-one



[0434] The title compound was prepared from 6-chloro-1*H*-quinazoline-2,4-dione (see McKee et al., *J. Amer. Chem. Soc.*, 69, 1947, 940) in 59% yield according to the procedures of examples 1B and 1C. ¹H NMR (400 MHz, DMSO-*d*₆): δ 13.44 (br s, 1H), 8.01 (d, 1H, *J* = 2.4 Hz), 7.85 (dd, 1H, *J* = 8.4, 2.4 Hz), 7.63 (d, 1H, *J* = 8.4 Hz). MS (ES) [*m*+*H*] calc'd for C₈H₄N₂OCl₂ 215, 217; found 215, 217.

Example 10B: 2-(2,6-Dichloro-4-oxo-4*H*-quinazolin-3-ylmethyl)-benzonitrile

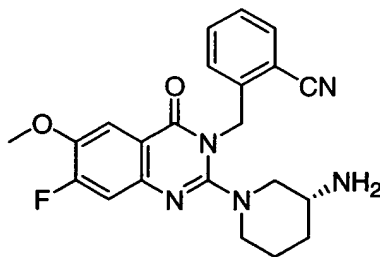


[0435] The title compound was prepared from 2,6-dichloro-3*H*-quinazolin-4-one in 63% yield according to the procedure for example 2B. ¹H NMR (400 MHz, CDCl₃): δ 8.26 (s, 1H), 7.72-7.77

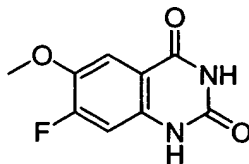
(m, 2H), 7.63 (d, 1H, $J = 8.8$ Hz), 7.54 (dt, 1H, $J = 7.6, 1.2$ Hz), 7.43 (t, 1H, $J = 7.6$ Hz), 7.15 (d, 1H, $J = 7.6$ Hz), 5.74 (s, 2H). MS (ES) $[m+H]$ calc'd for $C_{16}H_9N_3OCl_2$ 330, 332; found 330, 332.

[0436] The title compound, **Example 10**, 2-[2-(3-(*R*)-Amino-piperidin-1-yl)-6-chloro-4-oxo-4*H*-quinazolin-3-ylmethyl]-benzonitrile, TFA salt, was prepared from 2-(2,6-dichloro-4-oxo-4*H*-quinazolin-3-ylmethyl)-benzonitrile in 70% yield according to the procedure for example 1. 1H NMR (400 MHz, $DMSO-d_6$): δ 7.99 (br s, 3H), 7.88 (d, 1H, $J = 1.2$ Hz), 7.76-7.83 (m, 2H), 7.54-7.63 (m, 2H), 7.44 (t, 1H, $J = 7.6$ Hz), 7.25 (d, 1H, $J = 7.6$ Hz), 5.38 (AB q, 2H, $J = 48.0, 15.2$ Hz), 3.51-3.59 (m, 1H), 3.38-3.45 (m, 1H), 3.02-3.21 (m, 2H), 2.84-2.93 (m, 1H), 1.91-2.00 (m, 1H), 1.79-1.88 (m, 1H), 1.50-1.69 (m, 2H). MS (ES) $[m+H]$ calc'd for $C_{21}H_{20}N_5OCl$ 394, 396; found 394, 396.

Example 11: 2-[2-(3-(*R*)-Amino-piperidin-1-yl)-7-fluoro-6-methoxy-4-oxo-4*H*-quinazolin-3-ylmethyl]-benzonitrile, TFA salt

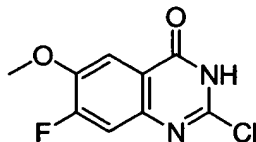


Example 11A: 7-Fluoro-6-methoxy-1*H*-quinazoline-2,4-dione



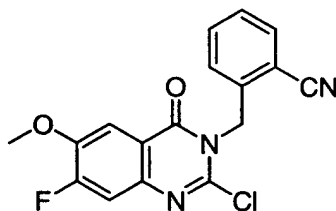
[0437] The title compound was prepared from 2-amino-4-fluoro-5-methoxy-benzoic acid methyl ester (see EP602851) in 90% yield according to the procedure for example 3A. 1H NMR (400 MHz, $DMSO-d_6$): δ 11.05 (br s, 2H), 7.50 (d, 1H, $J = 9.2$ Hz), 6.98 (d, 1H, $J = 12.0$ Hz), 3.88 (s, 3H). MS (ES) $[m+H]$ calc'd for $C_9H_7N_2O_3F$ 211; found 211.

Example 11B: 2-Chloro-7-fluoro-6-methoxy-3*H*-quinazolin-4-one



[0438] The title compound was prepared from 7-fluoro-6-methoxy-1*H*-quinazoline-2,4-dione in 80% yield according to the procedures of examples 1B and 1C. ¹H NMR (400 MHz, DMSO-*d*₆): δ 13.29 (br s, 1H), 7.62 (d, 1H, *J* = 9.2 Hz), 7.51 (d, 1H, *J* = 12.0 Hz), 3.95 (s, 3H). MS (ES) [*m*+*H*] calc'd for C₉H₆N₂O₂FCl 229, 231; found 229, 231.

Example 11C: 2-(2-Chloro-7-fluoro-6-methoxy-4-oxo-4*H*-quinazolin-3-ylmethyl)-benzonitrile

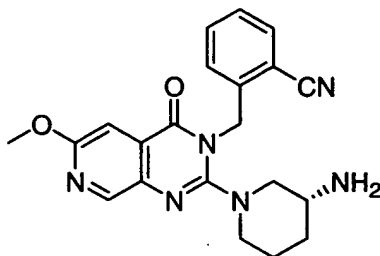


[0439] The title compound was prepared from 2-chloro-7-fluoro-6-methoxy-3*H*-quinazolin-4-one in 67% yield according to the procedure for example 2B. ¹H NMR (400 MHz, CDCl₃): δ 7.71-7.74 (m, 2H), 7.54 (dt, 1H, *J* = 7.6, 1.2 Hz), 7.36-7.44 (m, 2H), 7.14 (d, 1H, *J* = 7.6 Hz), 5.74 (s, 2H), 4.01 (s, 3H). MS (ES) [*m*+*H*] calc'd for C₁₇H₁₁N₃O₂FCl 344, 346; found 344, 346.

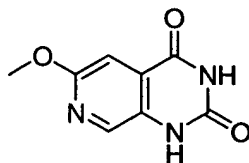
[0440] The title compound, **Example 11**, 2-[2-(3-(*R*)-Amino-piperidin-1yl)-7-fluoro-6-methoxy-4-oxo-4*H*-quinazolin-3-ylmethyl]-benzonitrile, TFA salt, was prepared from 2-(2-chloro-7-fluoro-6-methoxy-4-oxo-4*H*-quinazolin-3-ylmethyl)-benzonitrile in 85% yield according to the procedure for compound 1. ¹H NMR (400 MHz, DMSO-*d*₆): δ 7.93 (br s, 3H), 7.82 (d, 1H, *J* = 7.6 Hz), 7.60 (dt, 1H, *J* = 7.6, 1.2 Hz), 7.52 (d, 1H, *J* = 9.2 Hz), 7.38-7.46 (m, 2H), 7.21 (d, 1H, *J* = 7.6 Hz), 5.39 (AB q, 2H, *J* = 51.2, 15.2 Hz), 3.89 (s, 3H), 3.46-3.53 (m, 1H), 3.34-3.42 (m, 1H), 3.01-

3.18 (m, 2H), 2.81-2.89 (m, 1H), 1.91-1.99 (m, 1H), 1.78-1.86 (m, 1H), 1.49-1.70 (m, 2H). MS (ES) [m+H] calc'd for C₂₂H₂₂N₅O₂F 408; found 408.

Example 12: 2-[2-(3-(*R*)-Amino-piperidin-1-yl)-6-methoxy-4-oxo-4*H*-pyrido[3,4-*d*]pyrimidin-3-ylmethyl]-benzonitrile, TFA salt

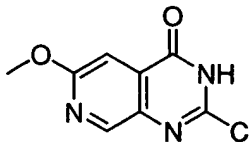


Example 12A: 6-Methoxy-1*H*-pyrido[3,4-*d*]pyrimidine-2,4-dione



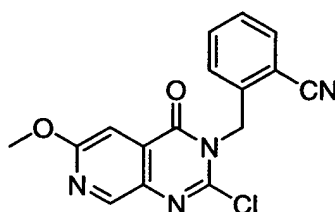
[0441] The title compound was prepared from 5-amino-2-methoxypyridine-4-carboxylic acid (see Rewcastle et al., *J. Chem. Soc. Perkin Trans. I*, **1996**, 2221-2226) in 77% yield according to the procedure for example 3A. ¹H NMR (400 MHz, DMSO-*d*₆); δ 11.29 (br s, 2H), 8.16 (s, 1H), 7.12 (s, 1H), 3.85 (s, 3H). MS (ES) [m+H] calc'd for C₈H₇N₃O₃ 194; found 194.

Example 12B: 2-Chloro-6-methoxy-3*H*-pyrido[3,4-*d*]pyrimidin-4-one



[0442] The title compound was prepared from 6-methoxy-1*H*-pyrido[3,4-*d*]pyrimidine-2,4-dione in 62% yield according to the procedures of examples **1B** and **1C**. ¹H NMR (400 MHz, DMSO-*d*₆): δ 13.32 (br s, 1H), 8.66 (s, 1H), 7.25 (s, 1H), 3.93 (s, 3H). MS (ES) [m+H] calc'd for C₈H₆N₃O₂Cl 212, 214; found 212, 214.

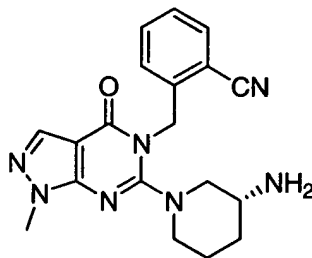
Example 12C: 2-(2-Chloro-6-methoxy-4-oxo-4*H*-pyrido[3,4-*d*]pyrimidin-3-ylmethyl)-benzonitrile



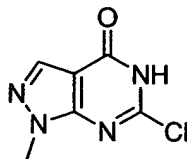
[0443] The title compound was prepared from 2-chloro-6-methoxy-3*H*-pyrido[3,4-*d*]pyrimidin-4-one in 63% yield according to the procedure for example **2B**. ¹H NMR (400 MHz, CDCl₃): δ 8.75 (s, 1H), 7.74 (dd, 1H, J = 7.6, 1.2 Hz), 7.55 (dt, 1H, J = 7.6, 1.2 Hz), 7.42-7.47 (m, 2H), 7.14 (d, 1H, J = 7.6 Hz), 5.72 (s, 2H), 4.04 (s, 3H). MS (ES) [m+H] calc'd for C₁₆H₁₁N₄O₂Cl 327, 329; found 327, 329.

[0444] The title compound, **Example 12**, 2-[2-(3-(*R*)-Amino-piperidin-1yl)-6-methoxy-4-oxo-4*H*-pyrido[3,4-*d*]pyrimidin-3-ylmethyl]-benzonitrile, TFA salt, was prepared from 2-(2-chloro-6-methoxy-4-oxo-4*H*-pyrido[3,4-*d*]pyrimidin-3-ylmethyl)-benzonitrile in 51% yield according to the procedure for example **1**. ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.62 (s, 1H), 7.94 (br s, 3H), 7.81 (d, 1H, J = 7.6 Hz), 7.60 (dt, 1H, J = 7.6, 1.2 Hz), 7.44 (t, 1H, J = 7.6 Hz), 7.26 (d, 1H, J = 7.6 Hz), 7.16 (s, 1H), 5.39 (AB q, 2H, J = 50.8, 15.2 Hz), 3.90 (s, 3H), 3.50-3.57 (m, 1H), 3.32-3.41 (m, 1H), 3.00-3.18 (m, 2H), 2.80-2.88 (m, 1H), 1.91-2.00 (m, 1H), 1.78-1.86 (m, 1H), 1.48-1.66 (m, 2H). MS (ES) [m+H] calc'd for C₂₁H₂₂N₆O₂ 391; found 391.

Example 13: 2-[6-(3-(*R*)-Amino-piperidin-1-yl)-1-methyl-4-oxo-1,4-dihydro-pyrazolo[3,4-*d*]pyrimidin-5-ylmethyl]-benzonitrile, TFA salt

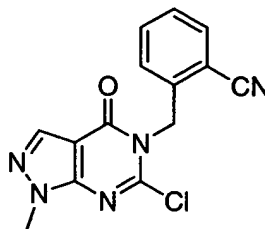


Example 13A: 6-Chloro-1-methyl-1,5-dihydro-pyrazolo[3,4-*d*]pyrimidin-4-one



[0445] The title compound was prepared from 1-methyl-1,7-dihydro-pyrazolo[3,4-*d*]pyrimidine-4,6-dione (see Cheng et al., *J. Org. Chem.*, 23, **1958**, 852-855) in 11% yield according to the procedures of examples **1B** and **1C**. ¹H NMR (400 MHz, MeOD-*d*₄): δ 8.00 (s, 1H), 3.92 (s, 3H). MS (ES) [*m*+H] calc'd for C₆H₅N₄OCl 185, 187; found 185, 187.

Example 13B: 2-(6-Chloro-1-methyl-4-oxo-1,4-dihydro-pyrazolo[3,4-*d*]pyrimidin-5-ylmethyl)-benzonitrile

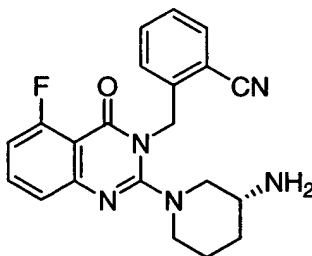


[0446] The title compound was prepared from 6-chloro-1-methyl-1,5-dihydro-pyrazolo[3,4-*d*]pyrimidin-4-one in 78% yield according to the procedure for example **2B**. ¹H NMR (400 MHz,

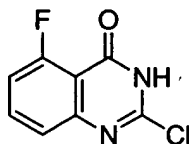
CDCl₃): δ 8.09 (s, 1H), 7.72 (dd, 1H, J = 7.6, 1.2 Hz), 7.53 (dd, 1H, J = 7.6, 1.2 Hz), 7.41 (t, 1H, J = 7.6 Hz), 7.10 (d, 1H, J = 7.6 Hz), 5.71 (s, 2H), 3.99 (s, 3H). MS (ES) [$m+H$] calc'd for C₁₄H₁₀N₅OCl 300, 302; found 300, 302.

[0447] The title compound, **Example 13**, 2-[6-(3-(*R*)-Amino-piperidin-1-yl)-1-methyl-4-oxo-1,4-dihydro-pyrazolo[3,4-*d*]pyrimidin-5-ylmethyl]-benzonitrile, TFA salt, was prepared from 2-(6-chloro-1-methyl-4-oxo-1,4-dihydro-pyrazolo[3,4-*d*]pyrimidin-5-ylmethyl)-benzonitrile in 72% yield according to the procedure for example 1. ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.00 (br s, 3H), 7.92 (s, 1H), 7.81 (dd, 1H, J = 7.6, 1.2 Hz), 7.59 (dt, 1H, J = 7.6, 1.2 Hz), 7.43 (t, 1H, J = 7.6 Hz), 7.15 (d, 1H, J = 7.6 Hz), 5.33 (AB q, 2H, J = 44.8, 15.2 Hz), 3.85 (s, 3H), 3.51-3.59 (m, 1H), 3.35-3.44 (m, 1H), 3.15-3.23 (m, 1H), 3.02-3.11 (m, 1H), 2.88-2.96 (m, 1H), 1.91-2.00 (m, 1H), 1.77-1.85 (m, 1H), 1.50-1.67 (m, 2H). MS (ES) [$m+H$] calc'd for C₁₉H₂₁N₇O 364; found 364.

Example 14: 2-[2-(3-(*R*)-Amino-piperidin-1-yl)-5-fluoro-4-oxo-4*H*-quinazolin-3-ylmethyl]-benzonitrile, TFA salt



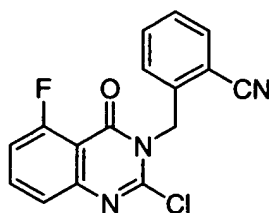
Example 14A: 2-Chloro-5-fluoro-3*H*-quinazolin-4-one



[0448] The title compound was prepared from 5-fluoro-1*H*-quinazoline-2,4-dione (see Michel et al., *Tetrahedron*, 53 (25), 1997, 8457-8478) in 11% yield according to the procedures of examples

1B and 1C. ^1H NMR (400 MHz, $\text{DMSO-}d_6$): δ 13.31 (br s, 1H), 7.77-7.83 (m, 1H), 7.41 (d, 1H, $J = 7.6$ Hz), 7.26-7.32 (m, 1H). MS (ES) [$m+H$] calc'd for $\text{C}_8\text{H}_4\text{N}_2\text{OFCI}$ 199, 201; found 199, 201.

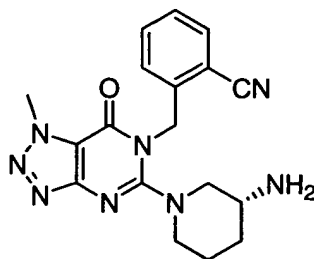
Example 14B: 2-(2-Chloro-5-fluoro-4-oxo-4*H*-quinazolin-3-ylmethyl)-benzonitrile



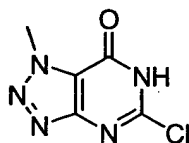
[0449] The title compound was prepared from 2-chloro-5-fluoro-3*H*-quinazolin-4-one in 70% yield according to the procedure for example **2B**. ^1H NMR (400 MHz, CDCl_3): δ 7.70-7.79 (m, 2H), 7.40-7.58 (m, 3H), 7.17-7.24 (m, 2H), 5.72 (s, 2H). MS (ES) [$m+H$] calc'd for $\text{C}_{16}\text{H}_9\text{N}_3\text{OFCI}$ 314, 316; found 314, 316.

[0450] The title compound, **Example 14**, 2-[2-(3-(*R*)-Amino-piperidin-1-yl)-5-fluoro-4-oxo-4*H*-quinazolin-3-ylmethyl]-benzonitrile, TFA salt, was prepared from 2-(2-chloro-5-fluoro-4-oxo-4*H*-quinazolin-3-ylmethyl)-benzonitrile in 53% yield according to the procedure for example **1**. ^1H NMR (400 MHz, $\text{DMSO-}d_6$): δ 7.81 (dd, 1H, $J = 7.6, 1.2$ Hz), 7.68-7.73 (m, 1H), 7.61 (dt, 1H, $J = 7.6, 1.2$ Hz), 7.44 (t, 1H, $J = 6.8$ Hz), 7.32 (d, 1H, $J = 7.6$ Hz), 7.26 (d, 1H, $J = 7.6$ Hz), 7.08-7.13 (m, 1H), 6.97 (br s, 2H), 5.33 (AB q, 2H, $J = 35.6, 15.2$ Hz), 3.49-3.55 (m, 1H), 3.17-3.36 (m, 2H), 2.81-2.99 (m, 2H), 1.90-1.99 (m, 1H), 1.78-1.86 (m, 1H), 1.41-1.66 (m, 2H). MS (ES) [$m+H$] calc'd for $\text{C}_{21}\text{H}_{20}\text{N}_5\text{OF}$ 378; found 378.

Example 15: 2-[5-(3-(*R*)-Amino-piperidin-1-yl)-1-methyl-7-oxo-1,7-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidin-6-ylmethyl]-benzonitrile, TFA salt

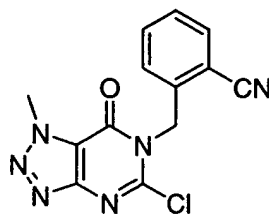


Example 15A: 5-Chloro-1-methyl-1,6-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidin-7-one



[0451] The title compound was prepared from 1-methyl-1,4-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidine-5,7-dione (see Smirnova et al., *J. Org. Chem. USSR Eng. Trans.*, 14, 1978, 1617) in 64% yield according to the procedures of examples 1B and 1C. ¹H NMR (400 MHz, DMSO-*d*₆): δ 13.39 (br s, 1H), 4.36 (s, 3H). MS (ES) [m+H] calc'd for C₅H₄N₅OCl 186, 188; found 186, 188.

Example 15B: 2-(5-Chloro-1-methyl-7-oxo-1,7-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidin-6-ylmethyl)-benzonitrile

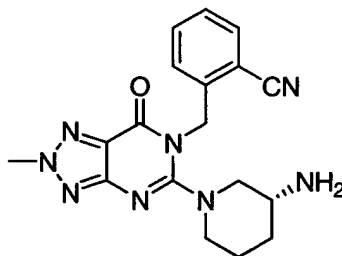


[0452] The title compound was prepared from 5-chloro-1-methyl-1,6-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidin-7-one in 70% yield according to the procedure for example 2B. ¹H

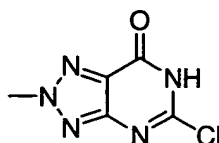
NMR (400 MHz, CDCl₃): δ 7.73 (dd, 1H, J = 7.6, 1.2 Hz), 7.55 (dt, 1H, J = 7.6, 1.2 Hz), 7.43 (t, 1H, J = 7.6 Hz), 7.10 (d, 1H, J = 7.6 Hz), 5.76 (s, 2H), 4.45 (s, 3H). MS (ES) [m+H] calc'd for C₁₃H₉N₆OCl 301, 303; found 301, 303.

[0453] The title compound, **Example 15**, 2-[5-(3-(*R*)-Amino-piperidin-1-yl)-1-methyl-7-oxo-1,7-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidin-6-ylmethyl]-benzonitrile, TFA salt, was prepared from 2-(5-chloro-1-methyl-7-oxo-1,7-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidin-6-ylmethyl)-benzonitrile in 46% yield according to the procedure for example 1. ¹H NMR (400 MHz, DMSO-*d*₆): δ 7.96 (br s, 3H), 7.81 (dd, 1H, J = 7.6, 1.2 Hz), 7.61 (dt, 1H, J = 7.6, 1.2 Hz), 7.44 (t, 1H, J = 7.6 Hz), 7.24 (d, 1H, J = 7.6 Hz), 5.38 (AB q, 2H, J = 48.0, 15.2 Hz), 4.31 (s, 3H), 3.49-3.56 (m, 1H), 3.31-4.41 (m, 1H), 3.22-3.30 (m, 1H), 2.98-3.06 (m, 1H), 2.82-2.90 (m, 1H), 1.91-1.99 (m, 1H), 1.77-1.85 (m, 1H), 1.48-1.65 (m, 2H). MS (ES) [m+H] calc'd for C₁₈H₂₀N₈O 365; found 365.

Example 16: 2-[5-(3-(*R*)-Amino-piperidin-1-yl)-2-methyl-7-oxo-2,7-dihydro[1,2,3]triazolo[4,5-*d*]pyrimidin-6-ylmethyl]-benzonitrile, TFA salt



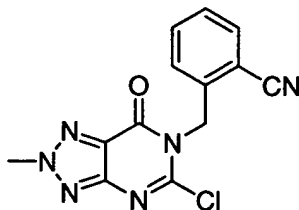
Example 16A: 5-Chloro-2-methyl-2,6-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidin-7-one



[0454] The title compound was prepared from 2-methyl-2,4-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidine-5,7-dione (see Smirnova et al., *J. Org. Chem. USSR Eng. Trans.*, 14, **1978**, 1617) in

36% yield according to the procedures of examples **1B** and **1C**. ^1H NMR (400 MHz, DMSO- d_6): δ 13.65 (br s, 1H), 4.30 (s, 3H). MS (ES) $[m+H]$ calc'd for $\text{C}_5\text{H}_4\text{N}_5\text{OCl}$ 186, 188; found 186, 188.

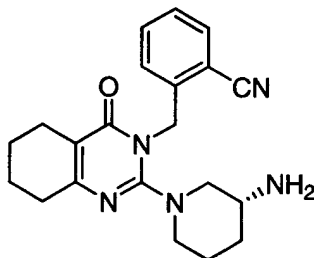
Example 16B: 2-(5-Chloro-2-methyl-7-oxo-2,7-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidin-6-ylmethyl)-benzonitrile



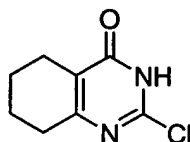
[0455] The title compound was prepared from 5-chloro-2-methyl-2,6-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidin-7-one in 58% yield according to the procedure for example **2B**. ^1H NMR (400 MHz, CDCl_3): δ 7.75 (dd, 1H, $J = 7.6, 1.2$ Hz), 7.57 (dt, 1H, $J = 7.6, 1.2$ Hz), 7.45 (t, 1H, $J = 7.6$ Hz), 7.09 (d, 1H, $J = 7.6$ Hz), 5.74 (s, 2H), 4.47 (s, 3H). MS (ES) $[m+H]$ calc'd for $\text{C}_{13}\text{H}_9\text{N}_6\text{OCl}$ 301, 303; found 301, 303.

[0456] The title compound, **Example 16**, 2-[5-(3-(*R*)-Amino-piperidin-1-yl)-2-methyl-7-oxo-2,7-dihydro[1,2,3]triazolo[4,5-*d*]pyrimidin-6-ylmethyl]-benzonitrile, TFA salt, was prepared from 2-(5-chloro-2-methyl-7-oxo-2,7-dihydro-[1,2,3]triazolo[4,5-*d*]pyrimidin-6-ylmethyl)-benzonitrile in 74% yield according to the procedure for example **1**. ^1H NMR (400 MHz, DMSO- d_6): δ 7.97 (br s, 3H), 7.83 (dd, 1H, $J = 7.6, 1.2$ Hz), 7.61 (dt, 1H, $J = 7.6, 1.2$ Hz), 7.46 (t, 1H, $J = 7.6$ Hz), 7.25 (d, 1H, $J = 7.6$ Hz), 5.39 (AB q, 2H, $J = 48.0, 15.2$ Hz), 4.24 (s, 3H), 3.49-3.56 (m, 1H), 3.31-4.41 (m, 1H), 3.22-3.30 (m, 1H), 2.98-3.06 (m, 1H), 2.82-2.90 (m, 1H), 1.91-1.99 (m, 1H), 1.77-1.85 (m, 1H), 1.48-1.65 (m, 2H). MS (ES) $[m+H]$ calc'd for $\text{C}_{18}\text{H}_{20}\text{N}_8\text{O}$ 365; found 365.

[0457] **Example 17:** 2-[2-(3-(*R*)-Amino-piperidin-1-yl)-4-oxo-5,6,7,8-tetrahydro-4*H*-quinazolin-3-ylmethyl]-benzonitrile, TFA salt

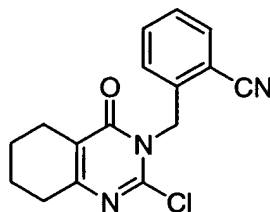


Example 17A: 2-Chloro-5,6,7,8-tetrahydro-3*H*-quinazolin-4-one



[0458] The title compound was prepared from 5,6,7,8-tetrahydro-1*H*-quinazoline-2,4-dione (see EP604920) in 47% yield according to the procedures of examples **1B** and **1C**. ¹H NMR (400 MHz, DMSO-*d*₆): δ 13.20 (br s, 1H), 2.58-2.72 (m, 4H), 1.75-1.92 (m, 4H). MS (ES) [m+H] calc'd for C₈H₉N₂OCl 185, 187; found 185, 187.

Example 17B: 2-(2-Chloro-4-oxo-5,6,7,8-tetrahydro-4*H*-quinazolin-3-ylmethyl)-benzonitrile

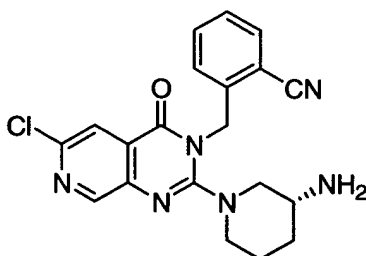


[0459] The title compound was prepared from 2-chloro-5,6,7,8-tetrahydro-3*H*-quinazolin-4-one in 59% yield according to the procedure for example **2B**. ¹H NMR (400 MHz, CDCl₃): δ 7.70 (dd, 1H, J = 7.6, 1.2 Hz), 7.55 (dt, 1H, J = 7.6, 1.2 Hz), 7.41 (t, 1H, J = 7.6 Hz), 7.14 (d, 1H, J = 7.6 Hz),

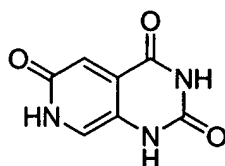
5.62 (s, 2H), 2.59-2.65 (m, 2H), 2.50-2.58 (m, 2H), 1.71-1.87 (m, 4H). MS (ES) [m+H] calc'd for C₁₆H₁₄N₃OCl 300, 302; found 300, 302.

[0460] 2-(2-Chloro-4-oxo-5,6,7,8-tetrahydro-4*H*-quinazolin-3-ylmethyl)-benzonitrile (150 mg, 0.5 mmol), 3-(*R*)-amino-piperidine dihydrochloride (104 mg, 0.6 mmol) and sodium bicarbonate (168 mg, 2.0 mmol) were stirred in ethanol (5 mL) at 60 °C for 2h. The reaction was diluted with EtOAc, washed with brine, dried (MgSO₄), and concentrated *in vacuo*. Purification by preparative HPLC gave 163 mg (68%) of the title compound, **Example 17**, 2-[2-(3-(*R*)-Amino-piperidin-1yl)-4-oxo-5,6,7,8-tetrahydro-4*H*-quinazolin-3-ylmethyl]-benzonitrile, TFA salt, as a white solid. ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.01 (br s, 3H), 7.82 (d, 1H, J = 7.6 Hz), 7.61 (t, 1H, J = 7.6 Hz), 7.44 (t, 1H, J = 7.6 Hz), 7.09 (d, 1H, J = 7.6 Hz), 5.26 (AB q, 2H, J = 44.8, 15.2 Hz), 3.25-3.40 (m, 2H), 2.90-3.08 (m, 2H), 2.70-2.80 (m, 1H), 2.48 (br s, 2H), 2.23 (br s, 2H), 1.89-1.98 (m, 1H), 1.42-1.80 (m, 7H). MS (ES) [m+H] calc'd for C₂₁H₂₅N₅O 364; found 364.

Example 18: 2-[2-(3-(*R*)-Amino-piperidin-1yl)-6-chloro-4-oxo-4*H*-pyrido[3,4-*d*]pyrimidin-3-ylmethyl]-benzonitrile, TFA salt



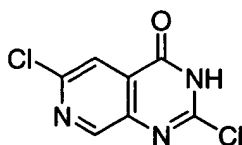
Example 18A: 1,7-Dihydro-pyrido[3,4-*d*]pyrimidine-2,4,6-trione



[0461] The title compound was prepared from 5-amino-2-hydroxypyridine-4-carboxylic acid (see Rewcastle et al., *J. Chem. Soc. Perkin Trans. I*, **1996**, 2221-2226) in 73% yield according to the

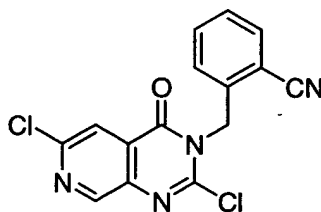
procedure for example 3A. ^1H NMR (400 MHz, $\text{DMSO}-d_6$): δ 11.02 (br s, 3H), 7.92 (s, 1H), 6.92 (s, 1H).

Example 18B: 2,6-Dichloro-3*H*-pyrido[3,4-*d*]pyrimidine-4-one



[0462] The title compound was prepared from 1,7-dihydro-pyrido[3,4-*d*]pyrimidine-2,4,6-trione in 16% yield according to the procedures of examples 1B and 1C. ^1H NMR (400 MHz, $\text{DMSO}-d_6$): δ 13.70 (br s, 1H), 8.84 (s, 1H), 7.96 (s, 1H).

Example 18C: 2-(2,6-Dichloro-4-oxo-4*H*-pyrido[3,4-*d*]pyrimidin-3-ylmethyl)-benzonitrile

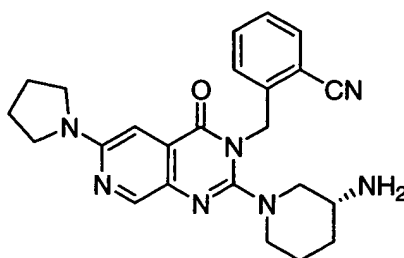


[0463] The title compound was prepared from 2,6-dichloro-3*H*-pyrido[3,4-*d*]pyrimidine-4-one in 63% yield according to the procedure for example 2B. ^1H NMR (400 MHz, CDCl_3): δ 8.91 (s, 1H), 8.10 (s, 1H), 7.75 (dd, 1H, $J = 7.6, 1.2$ Hz), 7.56 (dt, 1H, $J = 7.6, 1.2$ Hz), 7.45 (t, 1H, $J = 7.6$ Hz), 7.14 (d, 1H, $J = 7.6$ Hz), 5.74 (s, 2H). MS (ES) [$m+H$] calc'd for $\text{C}_{15}\text{H}_8\text{N}_4\text{OCl}_2$ 331, 333; found 331, 333.

[0464] The title compound, **Example 18**, 2-[2-(3-(*R*)-Amino-piperidin-1-yl)-6-chloro-4-oxo-4*H*-pyrido[3,4-*d*]pyrimidin-3-ylmethyl]-benzonitrile, TFA salt, was prepared from 2-(2,6-dichloro-4-oxo-4*H*-pyrido[3,4-*d*]pyrimidin-3-ylmethyl)-benzonitrile in 63% yield according to the procedure for example 17. ^1H NMR (400 MHz, $\text{DMSO}-d_6$): δ 8.77 (s, 1H), 8.03 (br s, 3H), 7.80-7.84 (m, 2H),

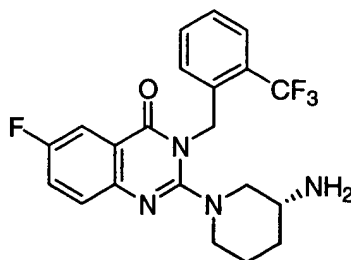
7.61 (t, 1H, J = 7.6 Hz), 7.45 (t, 1H, J = 7.6 Hz), 7.34 (d, 1H, J = 7.6 Hz), 5.37 (AB q, 2H, J = 44.4, 15.2 Hz), 3.41-3.60 (m, 2H), 3.20-3.27 (m, 1H), 3.06-3.14 (m, 1H), 2.89-2.97 (m, 1H), 1.94-2.02 (m, 1H), 1.79-1.87 (m, 1H), 1.51-1.69 (m, 2H). MS (ES) [m+H] calc'd for C₂₀H₁₉N₆OCl 395, 397; found 395, 397.

[0465] Example 19: 2-[2-(3-(R)-Amino-piperidin-1-yl)-4-oxo-6-pyrrolidin-1-yl-4H-pyrido[3,4-*d*]pyrimidin-3-ylmethyl]-benzonitrile

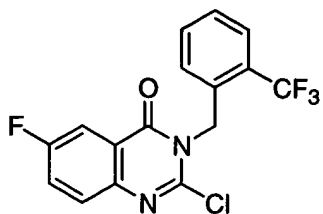


[0466] 2-[2-(3-(R)-Amino-piperidin-1-yl)-6-chloro-4-oxo-4H-pyrido[3,4-*d*]pyrimidin-3-ylmethyl]-benzonitrile (Example 18) (120 mg, 0.3 mmol), pyrrolidine (75 μ L, 0.91 mmol) and sodium bicarbonate (76 mg, 0.91 mmol) were stirred in EtOH in a sealed tube at 150 °C for 16 h. After cooling, the reaction was diluted with EtOAc, washed with brine, dried (MgSO₄), and concentrated *in vacuo*. Purification by preparative HPLC yielded 54 mg (32%) of the title compound as a bright orange solid. ¹H NMR (400 MHz, MeOD-*d*₄): δ 8.40 (s, 1H), 7.64 (dd, 1H, J = 7.6, 1.2 Hz), 7.48 (dt, 1H, J = 7.6, 1.2 Hz), 7.33 (t, 1H, J = 7.6 Hz), 7.07 (d, 1H, J = 7.6 Hz), 6.67 (s, 1H), 5.43 (s, 2H), 3.20-3.32 (m, 5H), 3.02-3.10 (m, 1H), 2.81-2.90 (m, 1H), 2.69-2.78 (m, 1H), 2.59-2.67 (m, 1H), 1.87-1.99 (m, 5H), 1.51-1.73 (m, 2H), 1.18-1.28 (m, 1H). MS (ES) [m+H] calc'd for C₂₄H₂₇N₇O 430; found 430.

Example 20: 2-[(R)-3-Amino-piperidin-1-yl]-6-fluoro-3-(2-trifluoromethyl-benzyl)-3H-quinazolin-4-one



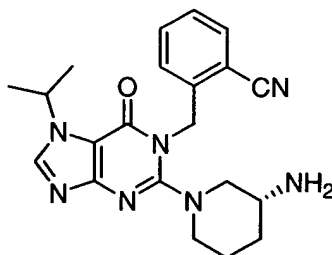
Example 20A: 2-Chloro-6-fluoro-3-(2-trifluoromethyl-benzyl)-3H-quinazolin-4-one



[0467] The title compound **Example 20A** was prepared from **6C** based on the procedures described in the synthesis of **1D**. Without further characterization, **20A** was converted to **Example 20** by the method used for **Example 1**.

[0468] **Example 20:** NMR (400 MHz CDCl_3 - CD_3OD 10:1): δ 8.56 (br s, 3H), 7.96 (s, 1H), 7.78 (d, 1H, $J = 7.6$ Hz), 7.52-7.7 (m, 5H), 5.88-5.76 (AB q, 2H, $J = 12.8$ Hz), 4.51 (m, 1H), 4.18 (m, 2H), 3.85 (m, 1H), 3.66 (m, 1H), 2.21 (m, 1H), 2.03 (m, 2H), 1.70 (m, 1H). MS (ES) $[m+H]$ calculated for $\text{C}_{21}\text{H}_{20}\text{FN}_4\text{O}+\text{H}$, 421.2, found 421.1.

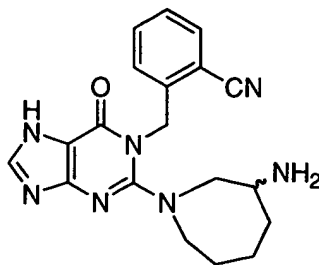
Example 21: 2-{2-[(R)-3-Amino-piperidin-1-yl]-7-isopropyl-6-oxo-6,7-dihydro-purin-1-ylmethyl}-benzonitrile



[0469] The title compound was prepared from **Example 9G** by treatment with NaH and isobutyl bromide, followed by the method used for **Example 1**.

[0470] **Example 21:** NMR (400 MHz CDCl_3 - CD_3OD 10:1): δ 7.88 (s, 1H), 7.72 (d, 1H, $J = 8$ Hz), 7.62 (d, 1H, $J = 7.6$ Hz), 7.57 (t, 1H, $J = 7.6$ Hz), 7.09 (t, 1H, $J = 7.6$ Hz), 5.73-5.52 (AB q, 2H, $J = 13.4$ Hz), 4.66 (m, 1H), 4.56 (d, 1H, $J = 13.2$ Hz), 4.21 (m, 1H), 3.4-3.2 (m, 3H), 2.01 (m, 1H), 1.77 (m, 1H), 1.66 (m, 1H), 1.55 (m, 1H), 1.49 (s, 3H), 1.48 (s, 3H). MS (ES) $[m+H]$ calculated for $\text{C}_{21}\text{H}_{25}\text{N}_7\text{O}+\text{H}$, 392.2, found 392.2.

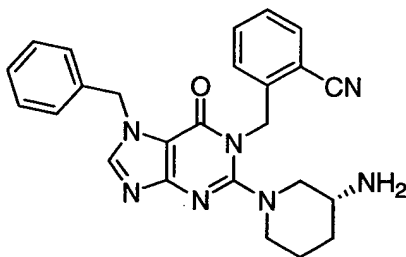
Example 22: 2-[2-(3-Amino-azepan-1-yl)-6-oxo-6,7-dihydro-purin-1-ylmethyl]-benzonitrile



[0471] The title compound was prepared from **Example 9G** using the method for **Example 1**.

[0472] **Example 22:** NMR (400 MHz CDCl₃-CD₃OD 10:1): δ 8.47 (s, 1H), 7.74 (m, 2H), 7.68 (t, 1H, J = 7.6 Hz), 7.52 (t, 1H, J = 7.6 Hz), 5.84-5.72 (AB q, 2H, J = 13.2 Hz), 4.17 (m, 1H), 3.81 (m, 1H), 3.59 (m, 1H), 3.29 (m, 1H), 2.21 (m, 1H), 1.88 (m, 2H), 1.62 (m, 1H), 1.44 (m, 2H). MS (ES) [m+H] calculated for C₁₉H₂₁N₇O+H, 363.2, found 363.3.

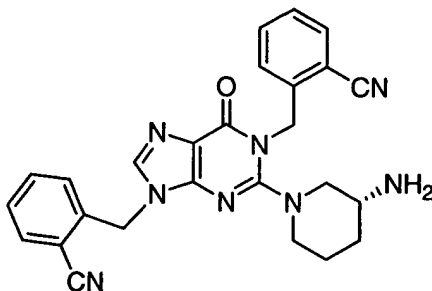
Example 23: 2-{2-[(R)-3-Amino-piperidin-1-yl]-7-benzyl-6-oxo-6-hydro-purin-1-ylmethyl}-benzonitrile



[0473] The title compound was prepared from **Example 9G** by treatment with NaH and benzyl bromide, followed by the method used for **Example 1**.

[0474] **Example 23:** NMR (400 MHz CDCl₃-CD₃OD 10:1): δ 7.88 (d, 1H, J = 7.6 Hz), 7.80-7.70 (m, 2H), 7.67-7.55 (m, 2H), 7.45 (t, 1H, J = 7.6 Hz), 7.22 (d, 1H, J = 8 Hz), 5.60-5.42 (m, 4H), 3.6-3.45 (m, 2H), 3.23-3.10 (m, 2H), 2.94 (m, 1H), 2.12 (m, 1H), 1.90-1.70 (m, 2H), 1.6 (m, 1H), 1.62 (m, 1H), 1.44 (m, 2H). MS (ES) [m+H] calculated for C₂₅H₂₅N₇O+H, 440.2, found 440.1.

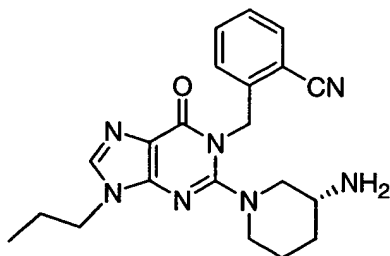
Example 24: 2-{2-[(R)-3-Amino-piperidin-1-yl]-9-(2-cyano-benzyl)-6-oxo-6-hydro-purin-1-ylmethyl}-benzonitrile



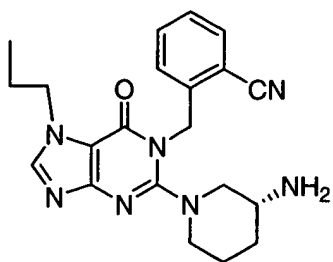
[0475] The title compound was prepared from **Example 9G** by treatment with NaH and δ -cyano-benzyl bromide and the procedure used for **Example 1**.

[0476] **Example 24:** NMR (400 MHz, CDCl_3 - CD_3OD 10:1): δ 7.86 (s, 1H), 7.74 (d, 1H, $J = 8$ Hz), 7.68-7.60 (m, 2H), 7.55-7.45 (m, 3H), 7.39-7.20 (m, 2H), 5.40-5.50 (m, 4H), 3.58 (d, 1H, $J = 12.8$ Hz), 3.52, (m, 1H), 3.21 (dd, 1H, $J = 8.8$ and 12 Hz), 3.06 (m, 2H), 2.10 (m, 1H), 1.87 (m, 1H), 1.70 (m, 2H). MS (ES) $[m+H]$ calculated for $\text{C}_{26}\text{H}_{24}\text{N}_8\text{O}+\text{H}$, 464.2, found 464.1.

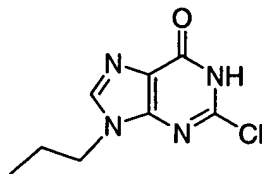
Example 25: 2-{2-[(R)-3-Amino-piperidin-1-yl]-6-oxo-9-propyl-6,9-dihydro-purin-1-ylmethyl}-benzonitrile



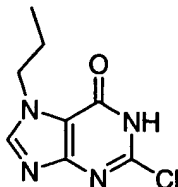
Example 26: 2-{2-[(R)-3-Amino-piperidin-1-yl]-6-oxo-7-propyl-6,7-dihydro-purin-1-ylmethyl}-benzonitrile



Example 25A: 2-Chloro-9-propyl-1,9-dihydro-purin-6-one



Example 26A: 2-Chloro-7-propyl-1,7-dihydro-purin-6-one

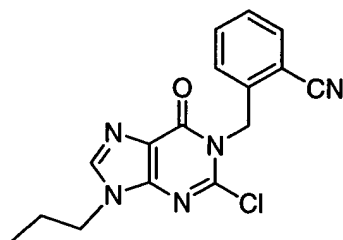


[0477] Compounds **25A** and **26A** were prepared from 2,6-dichloro-7H-purine by the methods used for **Example 7B** and **Example 8B**.

[0478] **Example 25A:** NMR (400 MHz CDCl_3): δ 7.96 (s, 1H), 4.14 (t, 2H, $J = 7.2$ Hz), 1.91 (m, 2H), 0.97 (t, 3H, $J = 7.6$ Hz). MS (ES) [$m+H$] calculated for $\text{C}_8\text{H}_9\text{ClN}_4\text{O}+H$, 213.1, found 213.1.

[0479] **Example 26A:** NMR (400 MHz CDCl_3): δ 8.33 (s, 1H), 4.37 (t, 2H, $J = 6.8$ Hz), 1.95 (m, 2H), 0.96 (t, 3H, $J = 7.6$ Hz). MS (ES) [$m+H$] calculated for $\text{C}_8\text{H}_9\text{ClN}_4\text{O}+H$, 213.1, found 213.1.

Example 25B: 2-(2-Chloro-6-oxo-9-propyl-6,9-dihydro-purin-1-ylmethyl)-benzonitrile

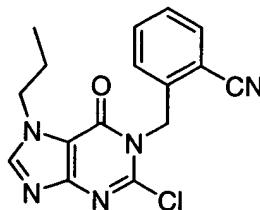


[0480] The title compound **Example 25B** was prepared from **25A** by the method used for **1D**.

[0481] **Example 25B:** NMR (400 MHz $\text{CDCl}_3\text{-CD}_3\text{OD}$ 10:1): δ 7.98 (s, 1H), 7.73 (d, 1H, $J = 8$ Hz), 7.55 (t, 1H, $J = 7.6$ Hz), 7.43 (t, 1H, $J = 7.6$ Hz), 7.14 (d, 1H, $J = 8$ Hz), 4.17 (t, 2H, $J = 7.2$ Hz),

1.94 (m, 2H), 1.00 (t, 3H, J = 7.2 Hz). MS (ES) [m+H] calculated for C₁₆H₁₄ClN₅O+H, 328.1, found 328.1.

Example 26B: 2-(2-Chloro-6-oxo-7-propyl-6,7-dihydro-purin-1-ylmethyl)-benzonitrile



[0482] The title compound **Example 26B** was prepared from **26A** by the method used for **1D**.

[0483] **Example 26B:** NMR (400 MHz CDCl₃-CD₃OD 10:1): δ 8.1 (s, 1H), 7.76 (d, 1H, J = 8 Hz), 7.58 (t, 1H, J = 7.6 Hz), 7.45 (t, 1H, J = 7.6 Hz), 7.10 (d, 1H, J = 8 Hz), 4.37 (t, 2H, J = 6.4 Hz), 1.94 (m, 2H), 0.97 (t, 3H, J = 6.8 Hz). MS (ES) [m+H] calculated for C₁₆H₁₄ClN₅O+H, 328.1, found 328.1.

[0484] The title compound, **Example 25**, was prepared from **Example 25B** by the method used for **Example 1**.

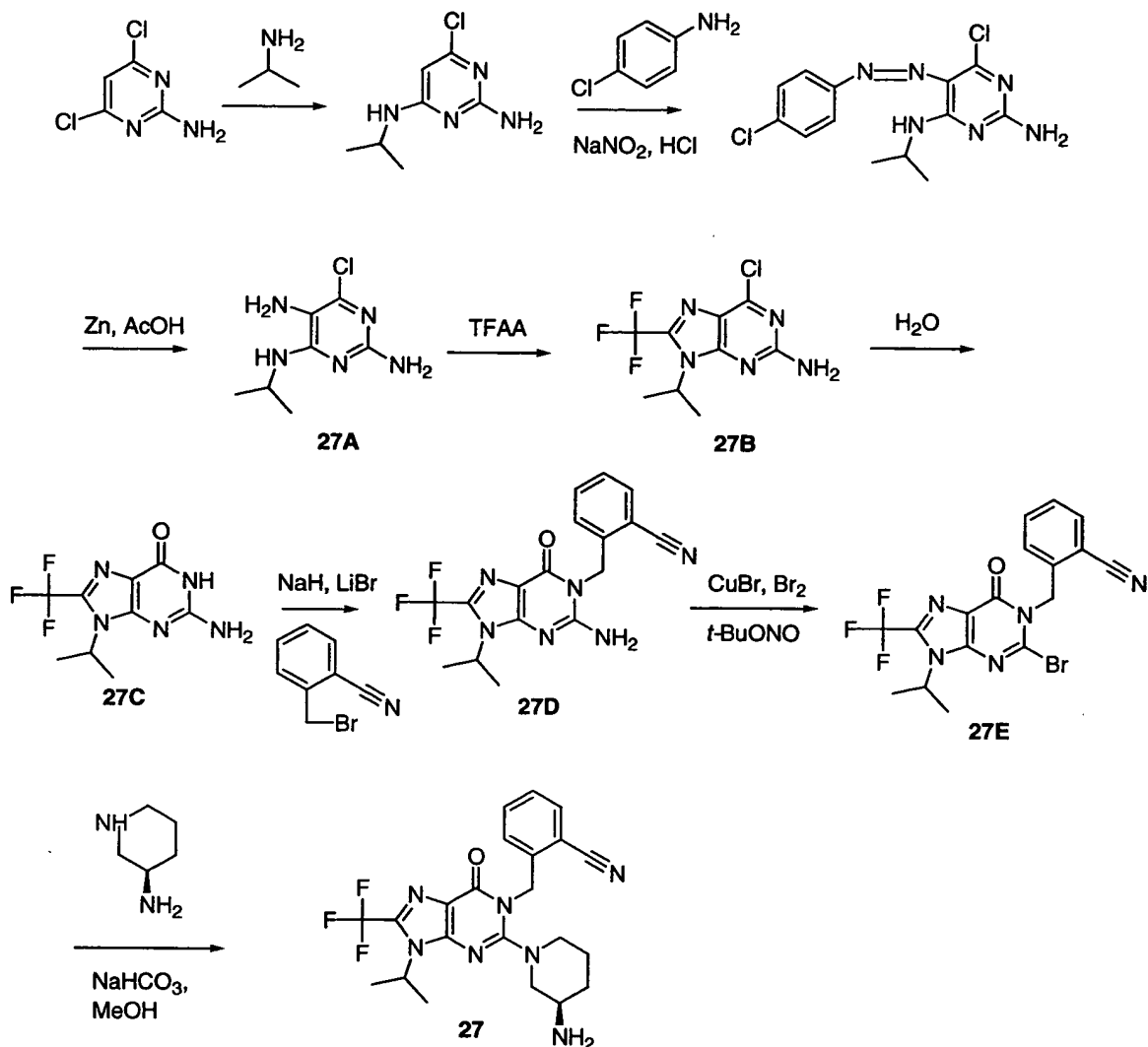
[0485]

[0486] **Example 25:** NMR (400 MHz CDCl₃-CD₃OD 10:1): δ 8.06 (s, 1H), 7.64 (d, 1H, J = 8 Hz), 7.55 (t, 1H, J = 7.6 Hz), 7.37 (t, 1H, J = 8 Hz), 7.22 (t, 1H, J = 7.6 Hz), 5.53-5.37 (AB q, 2H, J = 15.2 Hz), 4.14 (t, 1H, J = 7.2 Hz), 3.62 (d, 1H, J = 12.4 Hz), 3.51 (m, 1H), 3.19 (dd, 1H, J = 9.2 and 12.4 Hz), 3.12 (d, 1H, J = 12.4 Hz), 2.94 (m, 1H), 2.12 (m, 1H), 1.90 (m, 3H), 1.72 (m, 1H), 0.97 (t, 6H, J = 7.6 Hz). MS (ES) [m+H] calculated for C₂₁H₂₅N₇O+H, 392.2, found 392.2.

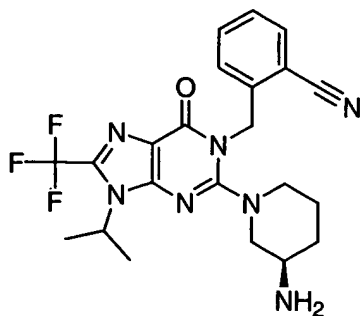
[0487] The title compound of **Example 26** was prepared from **Example 26B** by the method used for **Example 1**.

[0488] **Example 26:** NMR (400 MHz CDCl₃-CD₃OD 10:1): δ 7.92 (s, 1H), 7.69 (d, 1H, J = 8 Hz), 7.55 (t, 1H, J = 7.6 Hz), 7.41 (t, 1H, J = 8 Hz), 7.14 (t, 1H, J = 7.6 Hz), 5.60-5.37 (AB q, 2H, J = 15.6 Hz), 4.29 (t, 1H, J = 6.4 Hz), 3.54 (m, 2H), 3.19 (m, 2H), 2.95 (m, 1H), 2.11 (m, 1H), 1.88 (m, 3H), 1.70 (m, 1H), 0.92 (t, 6H, J = 7.2 Hz). MS (ES) [m+H] calculated for C₂₁H₂₅N₇O+H, 392.2, found 392.2.

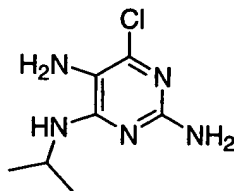
Scheme for the Preparation of Example 27



Example 27: 2-{2-[(R)-(3-Amino-piperidin-1-yl)]-9-isopropyl-6-oxo-8-trifluoromethyl-6,9-dihydro-purin-1-ylmethyl}-benzonitrile

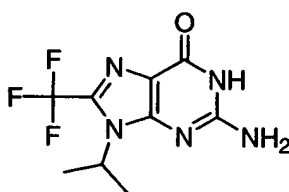


Example 27A: 6-Chloro-N4-isopropyl-pyrimidine-2,4,5-triamine



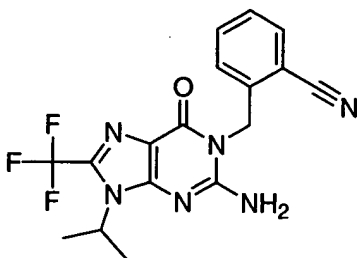
[0489] **Example 27A** was prepared from 4,6-Dichloro-pyrimidin-2-ylamine by the procedures described in J. Het. Chem., **1990**, 27, 1409.

Example 27B: 6-Chloro-9-isopropyl-8-trifluoromethyl-9H-purin-2-ylamine



[0490] To a mixture of 28A (1g, 5.0 mmol) and Et₃N in DMF (5 mL) was added a solution of trifluoroacetic anhydride in DMF (1mL) dropwise. After stirring at room temperature for 30 min, the mixture was heated at 120 °C overnight, then further heated at 160 °C for 5h. After cooling, the residue was suspended in hot water, and then cooled and filtered. The crude product was suspended in hot MeOH-water, cooled and filtered to give the title compound (1.2 g). MS (ES) [m+H] calculated for C₉H₁₀F₃N₅O+H, 262.1, found 262.2.

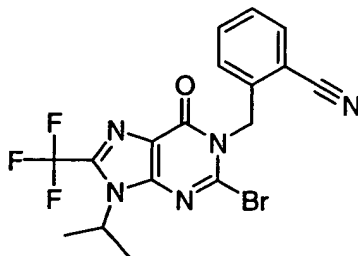
Example 27C: 2-(2-Amino-9-isopropyl-6-oxo-8-trifluoromethyl-6,9-dihydro-purin-1-ylmethyl)-benzonitrile



[0491] The title compound was prepared by converting **Example 27B** under the condition used for **1D**.

[0492] **Example 27C:** NMR (400 MHz CDCl₃-CD₃OD 10:1): δ 7.71 (d, 1H, J = 8.0 Hz), 7.57 (t, 1H, J = 8 Hz), 7.42 (t, 1H, J = 7.2 Hz), 7.20 (d, 1H, J = 8 Hz), 5.53 (s, 2H), 4.70 (m, 1H), 1.67 (d, 6H, J = 6.8 Hz). MS (ES) [m+H] calculated for C₁₇H₁₅F₃N₆O+H, 377.1, found 377.1.

Example 27D: 2-(2-Bromo-9-isopropyl-6-oxo-8-trifluoromethyl-6,9-dihydro-purin-1-ylmethyl)-benzonitrile



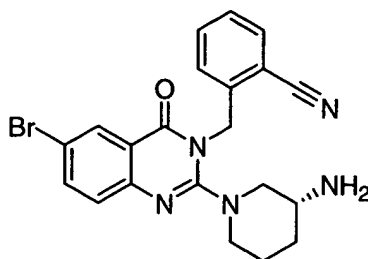
[0493] To a hot (60 °C) mixture of **Example 27C** (100 mg), Br₂ (50 μ L) and CuBr (60 mg) in CHCl₃ (4 mL), was added dropwise a solution of Br₂ (150 μ L) in CHCl₃ (200 μ L) and tert-butyl nitrite (300 μ L) at the same time. The mixture was refluxed for 1 h, and then diluted with CH₂Cl₂ and washed with 10% Na₂S₂O₃. The organic layer was dried and concentrated to give crude product (90 mg).

[0494] **Example 27E:** NMR (400 MHz CDCl₃-CD₃OD 10:1): δ 7.73 (d, 1H, J = 7.6 Hz), 7.56 (t, 1H, J = 7.2 Hz), 7.44 (t, 1H, J = 7.2 Hz), 7.11 (d, 1H, J = 7.6 Hz), 5.81 (s, 2H), 4.84 (m, 1H), 1.73 (d, 6H, J = 6.8 Hz). MS (ES) [m+H] calculated for C₁₇H₁₃BrF₃N₅O+H, 440.0, found 440.2.

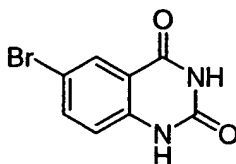
[0495] The title compound **Example 27**, 2-{2-[(R)-(3-Amino-piperidin-1-yl)]-9-isopropyl-6-oxo-8-trifluoromethyl-6,9-dihydro-purin-1-ylmethyl}-benzonitrile, was synthesized from **Example 27E** by the method used for **Example 1**.

[0496] **Example 27:** NMR (400 MHz CDCl₃-CD₃OD 10:1): δ 7.64-7.50 (m, 2H), 7.40-7.26 (m, 2H), 7.44 (t, 1H, J = 7.2 Hz), 7.11 (d, 1H, J = 7.6 Hz), 5.52-5.30 (AB q, 2H, J = 15.8 Hz), 4.76 (m, 1H), 3.7-3.50 (m, 2H), 3.18, (m, 2H), 2.94 (t, 1H, J = 10.0 Hz), 2.13 (m, 1H), 1.90 (m, 1H), 1.80-1.62 (m, 8H). MS (ES) [m+H] calculated for C₂₂H₂₄F₃N₇O+H, 460.2, found 460.3.

Example 28: 2-[2-(3-(R)-Amino-piperidin-1-yl)-6-bromo-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile

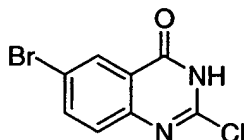


Example 28A: 6-Bromo-1H-quinazoline-2,4-dione



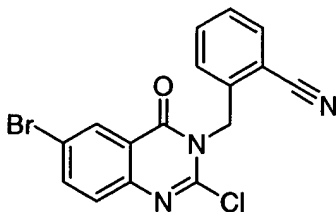
[0497] The title compound was prepared from Methyl 2-amino-5-bromo-benzoate in 90% yield according to the procedure for example 3A. MS: (ES) M+H calc'd for $C_8H_5BrN_2O_2$, 240, 242; found 240, 242.

Example 28B: 6-Bromo-2-chloro-3H-quinazolin-4-one



[0498] The title compound was prepared from **28A** according to the procedures of examples **1B** and **1C**. MS: (ES) M+H calc'd for $C_8H_4BrClN_2O$, 260; found 260.

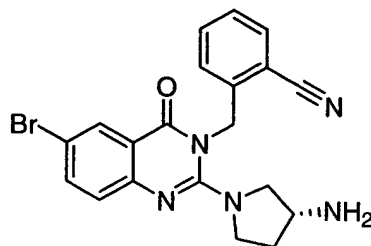
Example 28C: 2-(6-Bromo-2-chloro-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile



[0499] The title compound was prepared from **28C** as a mixture of N- and O- alkylation products according to the procedure for **1D**. MS: (ES) M+H calc'd for $C_{16}H_9BrClN_3O$, 375; found 375.

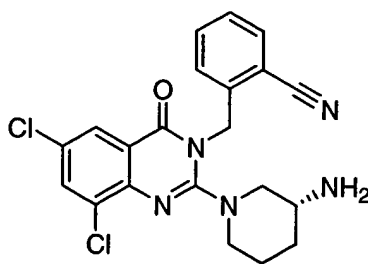
[0500] **Example 28** was prepared from **28C** according to the procedure for compound **1**. 1H NMR (400 MHz, $CDCl_3$): δ 8.23 (d, J = 1.77 Hz, 1H), 7.77 (d, J = 6.82 Hz, 1H), 7.61 (d, J = 7.33 Hz, 1H), 7.55 (dd, J = 7.58, 7.07 Hz, 1H), 7.43 - 7.49 (m, 1H), 7.31 - 7.41 (m, 2H), 5.44 (AB q, J = 137.18, 14.91 Hz, 2H), 3.48 - 3.81 (m, 3H), 3.18 - 3.34 (m, 2H), 1.83 - 2.14 (m, 3H), 1.64 - 1.76 (m, 1H). MS: (ES) M+H calc'd for $C_{21}H_{20}BrCN_5O$, 438; found 438.

Example 29: 2-[2-(3-(R)-Amino-pyrrolidin-1-yl)-6-bromo-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile, TFA salt

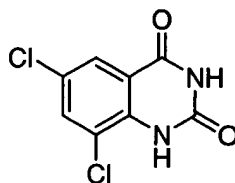


[0501] The title compound was prepared from **28C** according to the procedure for compound **1**. 1H NMR (400 MHz, DMSO- D_6): δ 7.97 (d, J = 2.27 Hz, 1H), 7.85 (d, J = 7.58 Hz, 1H), 7.78 (dd, J = 8.59, 2.53 Hz, 1H), 7.62 (dd, J = 6.82, 6.82 Hz, 1H), 7.46 (dd, J = 7.58, 7.07 Hz, 1H), 7.33 (d, J = 8.84 Hz, 1H), 7.27 (d, J = 7.83 Hz, 1H), 5.33 (s, 2H), 3.56 (m, 2H), 3.43 (m, 2H), 3.06 (m, 1H), 1.88 (m, 2H), 1.57 (m, 1H). MS: (ES) [m+H] calculated for $C_{20}H_{18}BrCN_5O$, 424, 426; found 424, 426.

Example 30: 2-[2-(3-(R)-Amino-piperidin-1-yl)-6,8-dichloro-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile

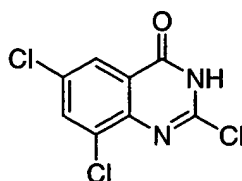


Example 30A: 6,8-Dichloro-1H-quinazoline-2,4-dione



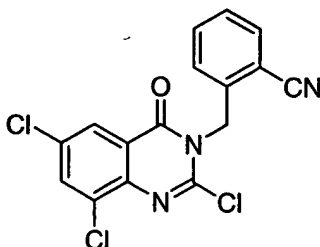
[0502] 2-Amino-3,5-dichlorobenzoic acid (1g, 4.85 mmol) and urea (1 g, 16.7 mmol) were heated together at 200 °C for 1 hour. The mixture was cooled and triturated with water. The solid was filtered and dried to give **30A** (0.9 mg, green solid, 80%). This material was used in the next step without further purification. MS: (ES) M+H calc'd for C₈H₄Cl₂N₂O₂, 230; found 230.

Example 30B: 2,6,8-Trichloro-3H-quinazolin-4-one



[0503] The title compound was prepared from 6,8-dichloro-1H-quinazoline-2,4-dione in 69% yield according to the procedures of examples **1B** and **1C**. MS: (ES) M+H calc'd for C₈H₃Cl₃N₂O, 250; found 250.

Example 30C: 2-(2,6,8-Trichloro-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile

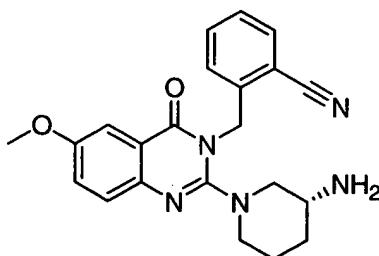


[0504] To a stirred solution of **30B** (400 mg, 1.6 mmol) in DME (4 mL) and DMF (1 mL) at 0 °C was added NaH (43 mg, 1.8 mmol, 95%). After ten minutes, LiBr (280 mg, 3.2 mmol) was added and the mixture was allowed to warm to RT. After 15 minutes, α-bromo-o-tolunitrile (350 mg, 1.8 mmol) was added and the mixture was heated at 65 °C overnight. After cooling, water (10

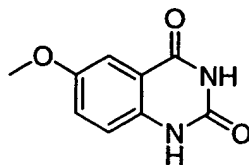
mL) was added. A precipitate formed. This precipitate was filtered and dried to give **30C** which was not further purified. MS (ES) [m+H] calculated for C₁₆H₈Cl₃N₃O, 363; found 363.

[0505] A mixture of **30C** (92 mg, 0.25 mmol), 3-aminopiperidine dihydrochloride (66 mg, 0.38 mmol), NaHCO₃ (63 mg, 0.75 mmol) and 2 mL of ethanol in a sealed tube was heated to 150 °C for 6 hours. After cooling to room temperature and filtering the inorganic salts, purification via LC/MS afforded 55 mg (51% yield) of product **30**. ¹H NMR (400 MHz, MeOD): δ 7.93 (d, J = 2.53 Hz, 1H), 7.88 (d, J = 2.53 Hz, 1H), 7.71 (dd, J = 7.58, 1.01 Hz, 1H), 7.61 (ddd, J = 7.58, 7.58, 1.26 Hz, 1H), 7.44 (dd, J = 7.58, 2.4 Hz, 1H), 7.39 (d, J = 7.83 Hz, 1H), 5.47 (AB q, J = 34.86, 15.16 Hz, 2H), 3.61 - 3.80 (m, 2H), 3.34 - 3.42 (m, 1H), 3.24 - 3.27 (m, 1H), 3.10 - 3.19 (m, 1H), 2.10 - 2.20 (m, 1H), 1.64 - 1.90 (m, 3H). MS: (ES) [m+H] calculated for C₂₁H₁₉Cl₂N₅O, 428; found 428.

Example 31: 2-[2-(3-(R)-Amino-piperidin-1-yl)-6-methoxy-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile

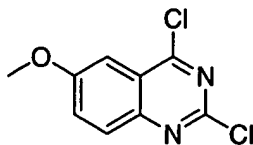


Example 31A: 6-Methoxy-1H-quinazoline-2,4-dione



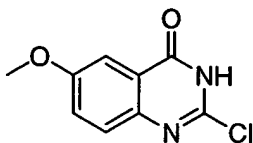
[0506] 2-Amino-5-methoxybenzoic acid (2g, 12 mmol) and urea (2.2 g, 36 mmol) were heated together at 200 °C for 1 hour. The mixture was cooled and triturated with water. The solid was filtered and dried to give **31A** (2.1 g, green solid, 90%). This material was used in the next step without further purification. MS: (ES) [m+H] calculated for C₉H₈N₂O₃, 193; found 193.

Example 31B: 2,4-Dichloro-6-methoxy-quinazoline



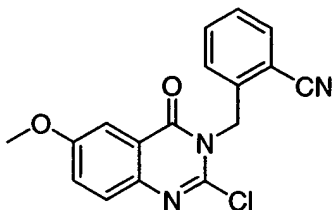
[0507] To 2.1 g of **31A** in 10 mL POCl₃ was added 0.5 mL N,N-dimethylaniline. The mixture was then heated at reflux for 16 hours. Excess POCl₃ was removed *in vacuo* and the residue was purified by column chromatography (Hexane: Ethyl acetate = 4:1), providing crude 1.8 g of product **31B**. MS (ES) [m+H] calculated for C₉H₆Cl₂N₂O, 230; found 230.

Example 31C: 2-Chloro-6-methoxy-3H-quinazolin-4-one



[0508] The title compound was prepared from **31C** in 80% yield according to the procedure for example **1C**. MS: (ES) [m+H] calculated for C₉H₇ClN₂O₂, 211; found 211.

Example 31D: 2-(2-Chloro-6-methoxy-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile

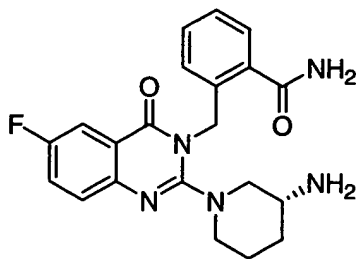


[0509] The title compound was prepared from **31C** in 91% yield according to the procedure for example **2B**. MS (ES) [m+H] calculated for C₁₇H₁₂ClN₃O₂, 326; found 326.

[0510] A mixture of **31** (99 mg, 0.3 mmol), 3-aminopiperidine dihydrochloride (80 mg, 0.46 mmol), NaHCO₃ (76 mg, 0.9 mmol) and 2 mL of ethanol in a sealed tube was heated to 120 °C for 6 hours. After cooling to room temperature and filtering the inorganic salts, purification via LC/MS afforded 38 mg (44% yield) of product **31**. ¹H NMR (400 MHz, CDCl₃): δ 7.53 - 7.68 (m, 3H), 7.32

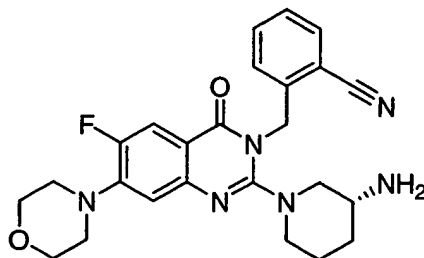
- 7.47 (m, 3H), 7.25 - 7.30 (m, 1H), 5.42 (AB q, $J = 72.76, 14.65$ Hz, 2H), 3.84 - 3.94 (m, 1H), 3.65 - 3.79 (m, 2H), 3.33 - 3.50 (m, 2H), 2.10 - 2.23 (m, 1H), 1.91 - 2.05 (m, 2H), 1.70 - 1.82 (m, 1H). MS: (ES) $[m+H]$ calculated for $C_{22}H_{23}N_5O_2$, 390; found 390.

Example 32: 2-[2-(3-(R)-Amino-piperidin-1-yl)-6-fluoro-4-oxo-4H-quinazolin-3-ylmethyl]-benzamide

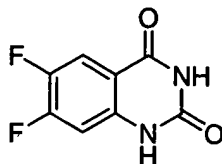


[0511] To a solution of 2-[2-(3-amino-piperidin-1-yl)-6-fluoro-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile (Example 6, 50 mg) in 5 mL of THF was added 2 mL of 1N NaOH, followed by 2 mL H_2O_2 . After stirring at room temperature overnight, the mixture was acidified with concentrated HCl. Removal of the solvent and purification by Preparative LC/MS provided the title compound. 1H NMR (400 MHz, MeOD): δ 7.68 - 7.74 (m, 1H), 7.59 - 7.66 (m, 1H), 7.48 - 7.58 (m, 2H), 7.29 - 7.40 (m, 2H), 7.02 (d, $J = 6.57$ Hz, 1H), 5.58 (AB q, $J = 22.74, 15.66$ Hz, 2H), 3.49 - 3.59 (m, 2H), 3.17 - 3.26 (m, 1H), 3.01 - 3.10 (m, 2H), 1.64 - 2.09 (m, 4H). MS: (ES) $[m+H]$ calculated for $C_{21}H_{22}FN_5O_2$, 396; found 396.

Example 33: 2-[2-(3-(R)-Amino-piperidin-1-yl)-6-fluoro-7-morpholin-4-yl-4-oxo-4H-quinazolin-3-ylmethyl]-benzonitrile

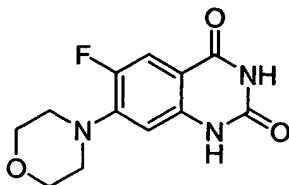


Example 33A: 6,7-Difluoro-1H-quinazoline-2,4-dione



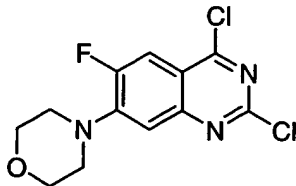
[0512] 2-Amino-4,5-difluorobenzoic acid (4g, 23 mmol) and urea (4.2 g, 69 mmol) were heated together at 200 °C for 1 hour. The mixture was cooled and triturated with water. The solid was filtered and dried to give **33A** (4.1 g, green solid, 90%). This material was used in the next step without further purification.

Example 33B: 6-Fluoro-7-morpholin-4-yl-1H-quinazoline-2,4-dione



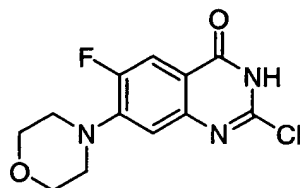
[0513] A mixture of **33A** (1g, 5.1 mmol) and 2mL of morpholine in 5 mL of DMSO was stirred at 90 °C for 2 hours. The mixture was diluted with water and acidified with concentrated HCl. The solid product was filtered out and dried under vacuum to give 1g (yield 74%) of product **33B**. MS: (ES) [m+H] calculated for C₁₂H₁₂FN₃O₃, 266; found 266.

Example 33C: 2,4-Dichloro-6-fluoro-7-morpholin-4-yl-quinazoline



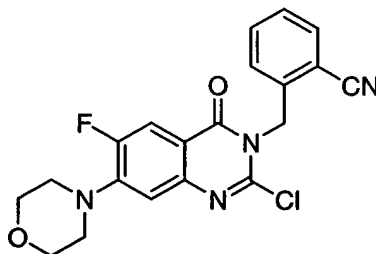
[0514] To 1 g of **33B** in 10 mL POCl₃ was added 0.5 mL N,N-dimethylaniline. The mixture was then heated at reflux for 16 hours. Excess POCl₃ was removed *in vacuo*, and the residue was purified by column chromatography (Hexane: Ethyl acetate = 4:1), providing 0.38 g of product **33C**. MS: (ES) [m+H] calculated for C₁₂H₁₀Cl₂FN₃O, 302; found 302.

Example 33D: 2-Chloro-6-fluoro-7-morpholin-4-yl-3H-quinazolin-4-one



[0515] A mixture of 5 mL of 1N NaOH, 10 mL of THF, and 0.38 g of **33C** was stirred at room temperature under N₂ overnight. The solution was acidified with HCl. The solids that precipitated were filtered to give 0.1 g (27%) of product **33D**. MS: (ES) [m+H] calculated for C₁₂H₁₁ClFN₃O₂, 384; found 384.

Example 33E: 2-(2-Chloro-6-fluoro-7-morpholin-4-yl-4-oxo-4H-quinazolin-3-ylmethyl)-benzonitrile

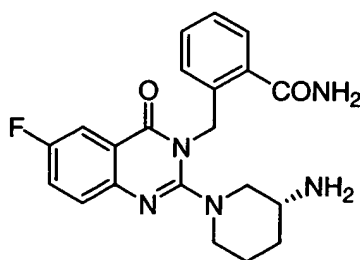


[0516] To a stirred solution of **33D** (100 mg, 0.35 mmol) in DME (2 mL) and DMF (0.5 mL) at 0 °C was added NaH (9.6 mg, 0.4 mmol). After ten minutes, LiBr (61 mg, 0.7 mmol) was added and the mixture was allowed to warm to RT. After 15 minutes, α-bromo-o-tolunitrile (76.4 mg, 0.39 mmol) was added and the mixture was heated at 65 °C overnight. After cooling, water (10 mL) was added. A precipitate formed. This precipitate was filtered and dried to give **33E** which was not further purified. MS: (ES) [m+H] calculated for C₂₀H₁₆ClFN₄O₂, 399; found 399.

[0517] A mixture of 50 mg of crude **33E**, 2 eq. of 3-aminopiperidine dihydrochloride, 5 eq. of NaHCO₃, and 2 mL of ethanol in a sealed tube was heated to 150 °C for 6 hours. After cooling to room temperature and filtering the inorganic salts, purification via LC/MS afforded 28 mg (47% yield) of product **33**. ¹H NMR (400 MHz, MeOD): δ 7.71 (d, J = 8.0 Hz, 1H), 7.55-7.62 (m, 2H), 7.43 (dd, J = 8.0, 7.2 Hz, 1H), 7.29 (d, J = 8.0 Hz, 1H), 7.07 (d, J = 8.0 Hz, 1H), 5.49 (AB q, J = 15.2,

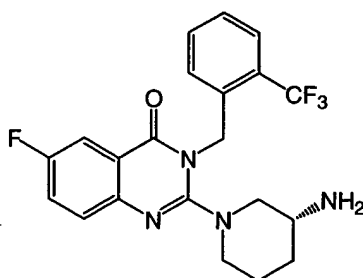
34.8 Hz, 2H), 3.82-3.90 (m, 4H), 3.49-3.65 (m, 2H), 3.15-3.27 (m, 6H), 2.92-3.02 (m, 1H), 2.09-2.17 (m, 1H), 1.60-1.90 (m, 3H). MS: (ES) [m+H] calculated for C₂₅H₁₇FN₆O₂, 463; found 463.

Example 34: 2-[2-(3-Amino-piperidin-1-yl)-6-fluoro-4-oxo-4H-quinazolin-3-ylmethyl]-benzamide



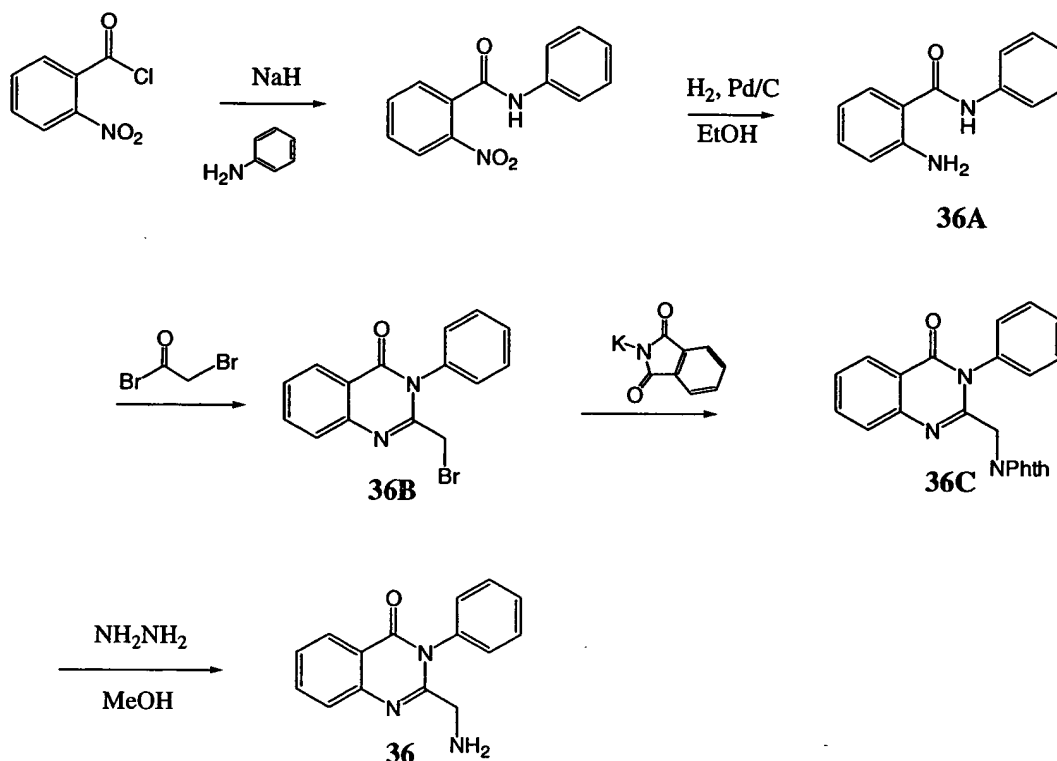
[0518] To a solution of **6E** in THF was added H₂O₂ (30%, 5mL) and 1N NaOH (5mL). The mixture was stirred at room temperature for 4 hours, neutralized by HCl and extracted with DCM. The organics were dried over MgSO₄ and the solvent removed in vacuo. The residue was purified by HPLC. ¹H NMR (400 MHz, CD₃OD): δ 7.74-7.48 (m, 4H), 7.28-7.39 (m, 2H), 7.02 (d, J=6.8Hz, 1H), 5.52-5.64 (AB q, J = 15.6, 22.8 Hz, 2H), 3.49-3.59 (m, 2H), 3.18-3.26 (m, 1H), 2.99-3.09 (m, 2H), 1.65-2.09 (m, 4H). MS (ES) [m+H] calculated for C₂₁H₂₂FN₅O₂, 395; found 395.

Example 35: 2-[3-(R)-Amino-piperidin-1-yl]-6-fluoro-3-(2-trifluoromethyl-benzyl)-3H-quinazolin-4-one

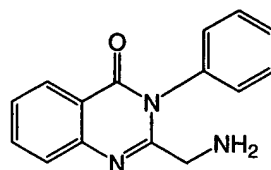


[0519] **Example 35** was synthesized from 2-Chloro-6-fluoro-3H-quinazolin-4-one (example **6C**) by two steps, benzylation and amine replacement. The procedure for benzylation was described in the synthesis of example **2B**, and the procedure for amine replacement was described in the synthesis of example **1**. ¹H-NMR (400 MHz, CDCl₃-CD₃OD, 10:1), δ 8.56 (s, 2 H), 7.96 (d, J=5.3

Hz, 1 H), 7.78 (d, $J=7.8$ Hz, 1 H), 7.56 - 7.67 (m, 5 H), 5.77 - 5.88 (ABq, $J = 10.6$ and 23.5 Hz, 2 H), 4.53 (brs, 1 H), 4.18 (s, 2 H), 3.86 (s, 1 H), 3.66 (s, 1 H), 2.21 (s, 1 H), 2.03 (s, 2 H), 1.71 (s, 1 H).
MS (ES) [$m+H$] calc'd for $C_{21}H_{21}F_4N_4O$, 421.2; found, 421.2.



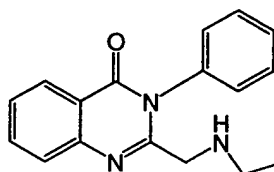
Example 36: 2-Aminomethyl-3-phenyl-3H-quinazolin-4-one



[0520] To a solution of 2-Amino-N-phenyl-benzamide, **36A**, (500 mg, 2.5 mmol) in THF (10 mL), was added bromo-acetyl bromide (2mL). The reaction was carried out at rt for 0.5 h, and then 50 °C for 2h, then concentrated *in vacuo*. The residue was dissolved in CH_2Cl_2 , washed with aq $NaHCO_3$, dried over Na_2SO_4 , and concentrated to give the crude product **36B** that was used for the next step without further purification.

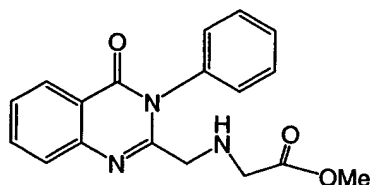
[0521] A mixture of compound **36B** (100 mg, 0.32 mmol) and potassium phthalimide (120 mg, 0.64 mmol) in dry DMF (3 mL) was heated at 100 °C for 5 h, then concentrated *in vacuo*. The residue was dissolved in CH₂Cl₂ washed with water, dried and concentrated to give crude product **36C**. Compound **36C** in MeOH (5 mL), was treated with NH₂NH₂ at rt for 2h, 50 °C for 5 min, and then dried *in vacuo*, co-evaporated with water, and purified by LC-MS to give compound **36**. ¹H-NMR (400 MHz, CDCl₃) δ 8.30 (d, *J*=7.8 Hz, 1 H), 7.73 - 7.82 (m, 2 H), 7.48 - 7.59 (m, 4 H), 7.22 - 7.28 (m, 2 H), 3.49 (s, 2H). MS (ES) [*m*+*H*] calc'd for C₁₅H₁₄N₃O, 252; found, 252.

Example 37: 2-Ethylaminomethyl-3-phenyl-3H-quinazolin-4-one



[0522] A solution of compound **36B** (100mg) in THF (0.5 mL) was added to a stirring solution of 2 M EtNH₂ in THF (2 mL). The mixture was stirred at rt for 2h, and then purified by LC-MS to give compound example 37. ¹H-NMR (400 MHz, CD₃Cl) δ ppm 8.21 (dd, *J*=8.1 and 1.5 Hz, 1 H) 7.80 (dt, *J*=7.1 and 1.2 Hz, 1 H), 7.72 (d, *J*= 7.8 Hz, 1H), 7.57-7.49 (m, 4 H) 7.28 (m, 2 H) 3.80 (s, 2 H) 3.08 (q, *J*=7.3 Hz, 2 H) 1.30 (t, *J*=7.2 Hz, 3 H). MS (ES) [*m*+*H*] calc'd for C₁₇H₁₈N₃O, 280; found, 280.

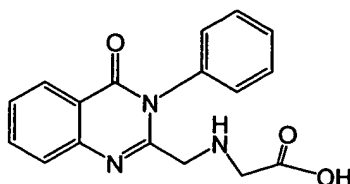
Example 38: [(4-Oxo-3-phenyl-3,4-dihydro-quinazolin-2-ylmethyl)-amino]-acetic acid methyl ester



[0523] To a pre-stirred mixture of glycine methyl ester hydrochloride (300 mg, 2.4 mmol) and NaHCO₃ (250 mg, 2.6 mmol) in DMF (3 mL) was added a solution of compound **36B** (80 mg, 0.25 mmol) in DMF (1mL). The mixture was stirred at rt for 2h, and purified by LC-MS to give

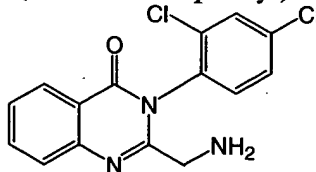
compound example 38. $^1\text{H-NMR}$ (400 MHz, CD_3OD) δ 8.22 (dd, $J=8.0, 1.4$ Hz, 1 H) 7.77 (dt, $J=7.6$ and 1.1 Hz, 1 H) 7.72 (d, $J=7.6$ Hz, 1 H) 7.46 - 7.56 (m, 4 H) 7.25 (m, 2 H) 3.61 (s, 3 H) 3.44 (s, 2 H) 3.41 (s, 2 H). MS (ES) $[m+H]$ calc'd for $\text{C}_{18}\text{H}_{18}\text{N}_3\text{O}_3$, 324; found, 324.

Example 39: [(4-Oxo-3-phenyl-3,4-dihydro-quinazolin-2-ylmethyl)-amino]-acetic acid



[0524] Compound 38 (45 mg, 0.14 mmol) in THF (3 ml) was treated with 2M aq LiOH (350 μL) at rt overnight. The residue was purified by LC-MS to give example 39. $^1\text{H-NMR}$ (400 MHz, MeOD) δ 8.24 (d, $J=7.8$ Hz, 1 H), 7.80 (t, $J=8.0$ Hz, 1 H), 7.74 (d, $J=7.9$ Hz, 1H), 7.50 - 7.60 (m, 4 H), 7.26 - 7.34 (m, 3 H), 3.87-3.90 (4H). MS (ES) $[m+H]$ calc'd for $\text{C}_{17}\text{H}_{16}\text{N}_3\text{O}_3$, 310; found, 310.

Example 40: 2-Aminomethyl-3-(2,4-dichloro-phenyl)-3H-quinazolin-4-one

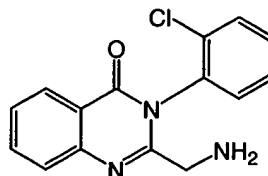


[0525] 2,4-dichloro-aniline (322 mg, 2.0 mmol) in DMF was treated with 95% NaH (53 mg, 2.1 mmol) at 0°C , and then 2-nitro-benzoyl chloride was added (390 mg, 2.1 mmol). After stirring for 2 h at rt, the mixture was concentrated and co-evaporated with water, diluted with CH_2Cl_2 , washed with aq. NaHCO_3 , dried and concentrated. The crude residue was dissolved in EtOH, and subjected to hydrogenation at 1 atm overnight, filtered through Celite and concentrated to give the crude product 2- amino-benzamide.

[0526] The crude product was converted to the title compound using the procedures described in the synthesis of example 36 to give example 40. $^1\text{H-NMR}$ (400 MHz, CDCl_3) δ ppm 8.21 (d, $J=7.8$ Hz, 1 H) 7.69 (t, $J=7.5\text{Hz}$, 1 H) 7.59 (d, $J=7.6$ Hz, 1 H) 7.55 (s, 1 H) 7.48 (t, $J=7.5$ Hz, 1 H) 7.38 (d,

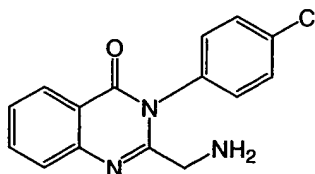
$J=8.1$ Hz, 1 H) 7.22 (d, $J=8.6$ Hz, 1 H) 3.74-3.58 (ABq, $J=15.2$ and 63.4 Hz, 2 H). MS (ES) [m+H] calc'd for $C_{15}H_{12}Cl_2N_3O$, 320; found, 320.

Example 41: 2-Aminomethyl-3-(2-chloro-phenyl)-3H-quinazolin-4-one



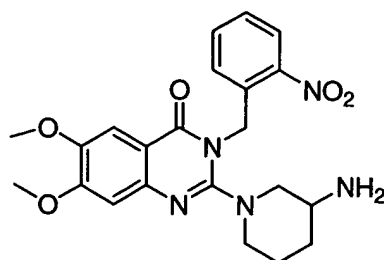
[0527] Example 41 was synthesized through the procedures described in the synthesis of example 40. $^1\text{H-NMR}$ (400 MHz, DMSO- D_6) δ 8.52 (s, 2 H) 8.21 (d, $J=7.3$ Hz, 1 H) 7.98 (t, $J=7.3$ Hz, 1 H) 7.81 (t, $J=7.1$ Hz, 2 H) 7.76 (d, $J=6.3$ Hz, 1 H) 7.66 (m, 3 H) 3.84 (d, $J=17.2$ Hz, 1 H), 3.43 (d $J=17.2$ Hz, 1 H). MS (ES) [m+H] calc'd for $C_{15}H_{13}ClN_3O$, 286; found, 286.

Example 42: 2-Aminomethyl-3-(4-chloro-phenyl)-3H-quinazolin-4-one



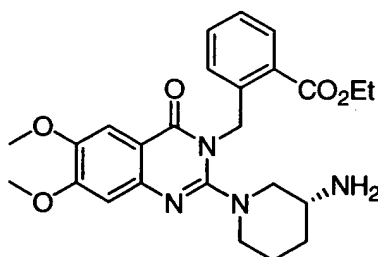
[0528] Example 42 was synthesized through the procedures described in the synthesis of example 40. $^1\text{H-NMR}$ (400 MHz, DMSO- D_6) δ ppm 8.45 (s, 2 H) 8.18 (d, $J=7.8$ Hz, 1 H) 7.95 (t, $J=7.6$ Hz, 1 H) 7.76 (d, $J=8.1$ Hz, 1 H) 7.71 (d, $J=8.1$ Hz, 2 H) 7.63 (t, $J=7.3$ Hz, 1 H) 7.57 (d, $J=8.3$ Hz, 2 H) 3.69 (s, 2 H). MS (ES) [m+H] calc'd for $C_{15}H_{13}ClN_3O$, 286; found, 286.

Example 43: 2-(3-Amino-piperidin-1-yl)-6,7-dimethoxy-3-(2-nitro-benzyl)-3H-quinazolin-4-one



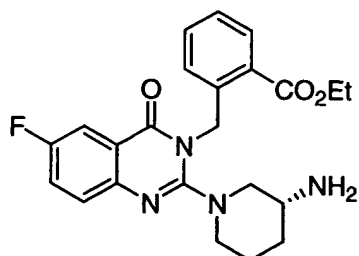
[0529] **2A** (242 mg, 1.01 mmol) was converted to 2-Chloro-6,7-dimethoxy-3-(2-nitro-benzyl)-3H-quinazolin-4-one by the method used for **Example 2B** using 2-nitrobenzylchloride in place of α -bromo-o-tolunitrile. The crude product was not further purified, but was converted to example **43** by the method used for example **1D**. ^1H NMR (400 MHz CDCl_3): δ 8.12 (dd, $J=1.2, 8.1$ Hz, 1H), 7.55 (s, 1H), 7.52 (m, 1H), 7.44 (t, $J = 8.1$ Hz, 1H), 7.03 (s, 1H), 7.01 (m, 1H), 5.73 (s, 2H), 4.03 (s, 3H), 3.98 (s, 3H), 3.24 (m, 1H), 3.12 (m, 1H), 2.89-2.79 (m, 2H), 2.64 (dd, $J=9, 11.7$ Hz, 1H), 1.91 (m, 1H), 1.73 (m, 1H), 1.29-1.21 (m, 2H). MS (ES) [$m+H$] calculated for $\text{C}_{22}\text{H}_{26}\text{N}_5\text{O}_5$, 440; found 440.

Example 44: 2-[2-(3-Amino-piperidin-1-yl)-6,7-dimethoxy-4-oxo-4H-quinazolin-3-ylmethyl]-benzoic acid ethyl ester



[0530] **Example 2A** was converted to 2-Chloro-6,7-dimethoxy-4-oxo-4H-quinazolin-3-ylmethyl)-benzoic acid ethyl ester using the procedure described for example **2B**, except that ethyl 2-bromomethylbenzoate [7115-91-5] was used in place of α -bromo-o-tolunitrile. The crude product was not further purified but was converted to example **44** using the method described for example **1**. ^1H NMR (400 MHz DMSO): δ 8.31 (m, 3H), 7.89 (d, $J=7.0$ Hz, 1H), 7.47 (m, 1H), 7.35 (m, 2H), 7.06 (s, 1H), 6.82 (d, $J=6.7$ Hz, 1H), 5.47-5.66 (AB q, $J = 16.4, 59.5$ Hz, 2H), 4.35 (m, 2H), 3.92 (s, 3H), 3.83 (s, 3H), 3.50 (m, 1H), 2.99-3.11 (m, 3H), 2.63 (m, 1H), 1.97 (m, 1H), 1.69 (m, 1H), 1.45 (m, 2H), 1.35 (t, $J=6.7$ Hz, 3H). MS (ES) [$m+H$] calculated for $\text{C}_{25}\text{H}_{31}\text{N}_4\text{O}_5$, 467; found 467.

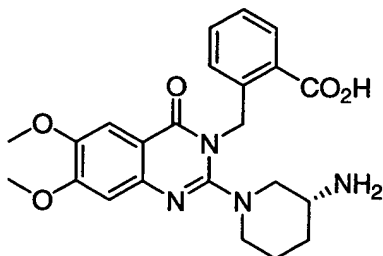
Example 45: 2-[2-(3-Amino-piperidin-1-yl)-6-fluoro-4-oxo-4H-quinazolin-3-ylmethyl]-benzoic acid ethyl ester



[0531] Example 6C was converted to 2-(2-Chloro-6-fluoro-4-oxo-4H-quinazolin-3-ylmethyl)-benzoic acid ethyl ester using the procedure described for example 2B, except that ethyl 2-bromomethylbenzoate [7115-91-5] was used in place of α -bromo-o-tolunitrile. The crude product was not further purified but was converted to example 45 using the method described for example 1.

^1H NMR (400 MHz CDCl_3): δ 8.03 (dd, $J=1.2, 7.7$ Hz, 1H), 7.84 (dd, $J=3.0, 8.4$ Hz, 1H), 7.61 (dd, $J=4.7, 9.0$ Hz, 1H), 7.44 (m, 2H), 7.34 (m, 1H), 6.91 (d, $J=7.7$ Hz, 1H), 5.77 (AB q, $J = 17.1, 24.0$ Hz, 2H), 4.41 (q, $J=7.2$ Hz, 2H), 3.34 (m, 1H), 3.23 (m, 1H), 3.09 (m, 2H), 2.98 (m, 1H), 1.89 (m, 1H), 1.72-1.78 (m, 2H), 1.57 (m, 1H), 1.43 (t, $J=7.1$ Hz, 3H). MS (ES) $[m+H]$ calculated for $\text{C}_{23}\text{H}_{26}\text{FN}_4\text{O}_3$, 425; found 425.

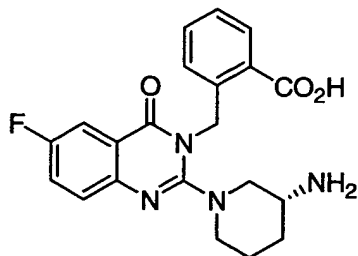
Example 46: 2-[2-(3-Amino-piperidin-1-yl)-6,7-dimethoxy-4-oxo-4H-quinazolin-3-ylmethyl]-benzoic acid



[0532] To a stirred solution of example 44 (HCl salt, 87 mg, 0.19 mmol) in THF (5 mL) was added LiOH (1M, 2 mL). The reaction was stirred overnight at RT. The mixture was concentrated and purified by HPLC to give example 46 (TFA salt, 86 mg, 82%). ^1H NMR (400 MHz DMSO): δ

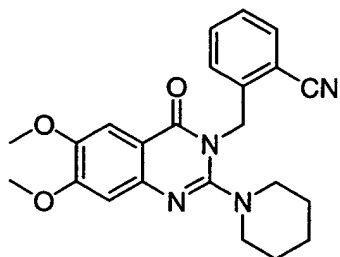
7.90-7.95 (m, 4H), 7.42 (m, 1H), 7.35 (m, 2H), 7.00 (s, 1H), 6.73 (d, J=7.6 Hz, 1H), 5.49-5.68 (AB q, J = 16.5, 59.0 Hz, 2H), 3.90 (s, 3H), 3.82 (s, 3H), 3.11 (m, 2H), 2.92 (m, 2H), 2.90 (m, 1H), 2.61 (m, 1H), 1.94 (m, 1H), 1.67 (m, 1H), 1.41 (m, 2H). MS (ES) [m+H] calculated for C₂₅H₂₆N₄O₅, 439; found 439.

Example 47: 2-[2-(3-Amino-piperidin-1-yl)-6-fluoro-4-oxo-4H-quinazolin-3-ylmethyl]-benzoic acid



[0533] Example 45 (70 mg, 0.17 mmol) was converted to the title compound (TFA salt, 61 mg, 70%) using the procedure described for Example 46. ¹H NMR (400 MHz, DMSO): δ 13.2 (br s, 1H), 7.99 (m, 3H), 7.91 (d, J=7.3 Hz, 1H), 7.56-7.69 (m, 3H), 7.41 (m, 1H), 7.34 (m, 1H), 6.85 (d, J=7.5 Hz, 1H), 5.58 (AB q, J = 16.9, 53.4 Hz, 2H), 3.52 (d, J=10.8 Hz, 1H), 3.14 (m, 2H), 2.95 (m, 1H), 2.65 (m, 1H), 1.95 (s, 1H), 1.67 (s, 1H), 1.42 (s, 2H). MS (ES) [m+H] calculated for C₂₁H₂₂FN₄O₃, 397; found 397.

Example 48: 2-(6,7-Dimethoxy-4-oxo-2-piperidin-1-yl-4H-quinazolin-3-ylmethyl)-benzonitrile



[0534] Example 2B (125 mg, 0.35 mmol) was converted to the title compound (50 mg) using the procedure described for Example 1, except that piperidine was used in the place of 3-aminopiperidine. ¹H NMR (400 MHz, DMSO): δ 7.83 (d, J=7.5 Hz, 1H), 7.59 (t, J=7.5 Hz, 1H), 7.42 (t, J=7.4 Hz, 1H), 7.32 (s, 1H), 7.04 (d, J=7.9 Hz, 1H), 6.99 (s, 1H), 5.40 (s, 2H), 3.89 (s, 3H),

3.80 (s, 3H), 2.98 (br s, 4H), 1.53 (br s, 6H). MS (ES) [m+H] calculated for C₂₃H₂₅N₄O₃, 405; found 405.

4. Examples Of *In vitro* Assays

[0535] The protease inhibitory activities of DPP-IV inhibitors can be readily determined by methods known to those of ordinary skill in the art since suitable *in vitro* assays for measuring protease activity and the inhibition thereof by test compounds are known. Examples of assays that may be used for measuring protease inhibitory activity and selectivity are set forth below.

DPP-IV Assay

[0536] Solutions of test compounds in varying concentrations (≤ 10 mM final concentration) were prepared in Dimethyl Sulfoxide (DMSO) and then diluted into assay buffer comprising: 20 mM Tris, pH 7.4; 20 mM KCl; and 0.1 mg/mL BSA. Human DPP-IV (0.1 nM final concentration) was added to the dilutions and pre-incubated for 10 minutes at ambient temperature before the reaction was initiated with A-P-7-amido-4-trifluoromethylcoumarin (AP-AFC; 10 μ M final concentration). The total volume of the reaction mixture was 10-100 μ L depending on assay formats used (384 or 96 well plates). The reaction was followed kinetically (excitation $\lambda=400$ nm; emission $\lambda=505$ nm) for 5-10 minutes or an end-point was measured after 10 minutes. Inhibition constants (IC₅₀) were calculated from the enzyme progress curves using standard mathematical models.

FAP α Assay

[0537] Solutions of test compounds in varying concentrations (≤ 10 mM final concentration) were prepared in Dimethyl Sulfoxide (DMSO) and then diluted into assay buffer comprising: 20 mM Tris, pH 7.4; 20 mM KCl; and 0.1 mg/mL BSA. Human FAP α (2 nM final concentration) was added to the dilutions and pre-incubated for 10 minutes at ambient temperature before the reaction was initiated with A-P-7-amido-4-trifluoromethylcoumarin (AP-AFC; 40 μ M final concentration). The total volume of the reaction mixture was 10-100 μ L depending on assay formats used (384 or 96 well plates). The reaction was followed kinetically (excitation $\lambda=400$ nm; emission $\lambda=505$ nm) for 5-10 minutes or an end-point was measured after 10 minutes. Inhibition constants (IC₅₀) were calculated from the enzyme progress curves using standard mathematical models.

PREP Assay

[0538] Solutions of test compounds in varying concentrations ($\leq 10\text{mM}$ final concentration) were prepared in Dimethyl Sulfoxide (DMSO) and then diluted into assay buffer comprising: 20mM Sodium Phosphate, pH 7.4; 0.5mM EDTA; 0.5mM DTT; and 0.1mg/mL BSA. PREP (EC3.4.21.26 from *Flavobacterium meningosepticum*; 0.2 nM final concentration) was added to the dilutions. The PREP and compound were pre-incubated for 10 minutes at ambient temperature before the reaction was initiated with Z-G-P-AMC (10 μM final concentration). The total volume of the reaction mixture was 10-100 μL depending on assay formats used (384 or 96 well plates). The reaction was followed kinetically (excitation $\lambda=375\text{ nm}$; emission $\lambda=460\text{ nm}$) for 10 minutes or an end-point was measured after 10 minutes. Inhibition constants (IC_{50}) were calculated from the enzyme progress curves using standard mathematical models.

Tryptase Assay

[0539] Solutions of test compounds in varying concentrations ($\leq 10\text{mM}$ final concentration) were prepared in Dimethyl Sulfoxide (DMSO) and then diluted into assay buffer comprising: 100mM Hepes, pH 7.4; 0.01% Brij35; and 10% glycerol. Tryptase (rhLung beta; 0.1 nM final concentration) was added to the dilutions and pre-incubated with compound for 10 minutes at ambient temperature. The enzymatic reaction was initiated with 25 μM Z-lys-SBzl and 400 μM DTNB. The total volume of the reaction mixture was 100 μL in Costar A/2 96 well plates. The reaction was followed colorimetrically ($\lambda=405\text{ nm}$) for 10 minutes. Inhibition constants (IC_{50}) were calculated from the enzyme progress curves using standard mathematical models.

[0540] Compounds of the invention were tested according to the above-described assays for protease inhibition and observed to exhibit selective DPP-IV inhibitory activity. For example, compounds of the invention were found to inhibit DPP-IV activity at concentrations that are at least 50 fold less than those concentrations required to produce an equiactive inhibition of protease activity for FAP α . The apparent inhibition constants (K_i) for compounds of the invention, against DPP-IV, were in the range from about 10^{-9}M to about 10^{-5}M .

Microsomal Stability:

[0541] Several compounds were evaluated for stability in rat liver microsomes.

[0542] The test compounds (1 μ M) were incubated at 37 °C in phosphate buffer (50 mM, pH 7.4) containing rat liver microsomes (1 mg/mL protein) and NADPH (Nicotinamide Adenine Dinucleotide Phosphate, reduced form) (4 mM). The incubation mixtures were quenched with trichloroacetic acid (0.3 M) over 0, 5, 15, 30 min time-course. Quenched solutions were centrifuged and supernatants were transferred for LC/MS quantitation. The half life of a test compounds was derived from the compound stability curve over the time course.

[0543] As can be seen from the test results in Table 1, substitution at the 6 and/or 7 position of the compounds of Formula II appears to significantly improve the compound metabolic stability relative to the 6 and/or 7 unsubstituted analogues. Accordingly, one aspect of the present invention relates to the DPP-IV inhibitors as described herein where the compounds of Formula II are substituted at the 6 and/or 7 position.

[0544] In one variation, substituents at the 6 and/or 7 position are independently selected from the group consisting of halo, perhalo(C₁₋₁₀)alkyl, CF₃, aminosulfonyl, alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, aryloxy, heteroaryloxy, amino, thio, cyano, nitro, alkoxy, aryloxy, carbonyl group, imine group, sulfonyl group and sulfinyl group, each substituted or unsubstituted.

[0545] In another particular variation, substituents at the 6 and/or 7 position are independently selected from the group consisting of alkyl, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkyl, and heterocycloalkyl, each substituted or unsubstituted.

[0546] In yet another particular variation, substituents at the 6 position are selected from the group consisting of halo, substituted or unsubstituted (C₁₋₁₀)alkoxy, cyano, nitro, and substituted or unsubstituted heteroaryloxy.

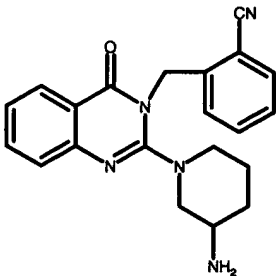
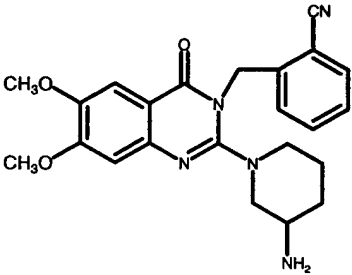
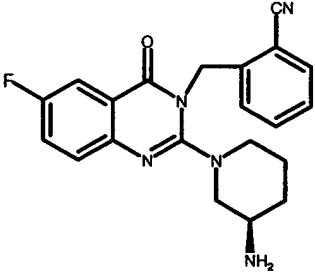
[0547] In yet another particular variation, DPP-IV inhibitors comprising the Formula II are substituted as the 6-chloro, 6-bromo, 6-fluoro, 6-iodo, 6-methoxy, 7-fluoro, or 6,7-dimethoxy quinazolinone derivatives. In another particular embodiment, DPP-IV inhibitors comprising the Formula II wherein L is nitrogen and the 6-position substituents are selected from the group consisting of halo, (C₁₋₁₀)alkoxy, cyano, nitro, morpholin-4-yl, pyrrolidin-1-yl, and heteroaryloxy, each substituted or unsubstituted.

[0548] In yet another variation, DPP-IV inhibitors comprising the Formula II are substituted as the 6,7-disubstituted derivatives, where substituents at the 6 and 7 positions are independently selected from the group consisting of bromo, chloro, fluoro, iodo, (C₁₋₁₀)alkoxy, cyano, nitro,

morpholin-4-yl, pyrrolidin-1-yl and heteroaryloxy, each substituted or unsubstituted. In a particular variation, DPP-IV inhibitors comprising the Formula II are substituted as the 6-fluoro,7-morpholin-1-yl quinazolinone derivatives.

[0549] The improvement in stability in rat liver microsomes for specific compounds that are substituted at the 6 and/or 7 position of the compound of Formula II are shown in Table 1.

TABLE 1

Example Number	Structure	Species	T _{1/2} (min.)
<u>1</u>		Rat	2.5
<u>2</u>		Rat	106.6
<u>6</u>		Rat	31

[0550] It will be apparent to those skilled in the art that various modifications and variations can be made to the compounds, compositions, kits, and methods of the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.